SECOND SERIES VOL. VII, No. 9

BULLETIN

OF

THE NEW YORK ACADEMY OF MEDICINE

SEPTEMBER, 1931

INCORPORATED 1851

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EDITORIAL

RUSSIAN MEDICINE UNDER THE OLD REGIME.[1]

There is a generalization of the French anthropologist, Lapouge, to the effect that the conqueror or settler in a strange region assimilates himself in the end to the conquered (native) people.[2] It will be found upon examination, that this theorem is not of universal validity and is, perhaps, not even true in all its parts. In other words, it may be true in certain latitudes and longitudes or periods of time but not in others, and is perhaps better understood in the light of Tredgold's dictum: "The environment of today is the heredity of tomorrow." The Normans in Sicily were mongrelized to the point of extinction. The English in Ireland became proverbially "more Irish than the Irish themselves"; but the Normans in Normandy remained Norsemen, the Celts in Brittany, Wales, Ireland, Cornwall and the Scotch Highlands remained Celts, albeit profoundly influenced by environment, just as German-Americans, Irish-Americans or Jewish-Americans are different, in many respects, from Germans born in Germany, Irishmen born in Ireland or Jews born in Europe, Asia Minor or North Africa. In the case of Russia, an area covering one-sixth of the land surface of the globe and comprising 150 millions of its people, the effect of environment seems indubitable and ineluctable. Russia in Europe is a vast plateau, surrounded by lofty mountains sloping to level

[1] Lecture delivered at the Institute for History of Medicine, Welch Medical Library, Baltimore, Maryland on March 26, 1931.

[2] G. de Lapouge: *Rev. d'anthrop.*, Paris, 1887, XVI, 524.

plains, with little to diversify the monotony except a fringe of foothills and the valleys of mighty rivers, so well paired and parallel in their courses that communication by portage and canals is easy. The Russian rivers, so prominent in the Russian poetry and music, have come to be regarded as more efficient agencies of national unity and commerce than the institutions of the country or even its railways. A climate ranging from 86°-109° F. in summer to 13°-54° below zero in winter, singularly uniform, from the Arctic to the Black and Caspian Seas, yet with little rainfall; the isolation occasioned by relative lack of seaboard; the continuity of the selfsame plateau formation, called by the Germans *"die grosse Ebene,"* from the Baltic and the Ural Mountains to the Pacific—all these monotones make for uniformity, standardization, centralization, the assimilation of the individual to the environment. Scythian and Sarmatian, Greek and Norseman, Finn, Hun and Bulgar, Tatar and Turk have all of them overrun the Russian plateau in their day, and like the big German immigrations in the 18th and 19th centuries, all have been assimilated to the Slavic type. The Russian winter, the passive resistance of the people, proved too much even for the great Napoleon, and Falkenhayn, fearful of the same *salto mortale* "in the air," rejected Ludendorff's plan of a clean sweep over the Russian lines of communication, remote from his basic commissariat. Catherine the Great, a Prussian princess, bred in the straight-laced code of the 18th century Lutheran, became more Russian in spirit, more Asiatic in morals, than the Orlovs or Potemkin or the daughter of Peter the Great. The same extraordinary power of assimilation is sensed in the political and social institutions: at one extreme, the *mir* or peasant village community, at the other a Byzantine bureaucracy so taut, so minute in its ramifications that there were said at one time to be more official dog-catchers in St. Petersburg than dogs. Such forcible Russianization as that of Finland was not the work of the people, but of bureaucrats and clerks. Evolution, from *volost* (canton) to *zemstvo* (provincial or district) government up to the *duma*, effected little of con-

sequence. The reforms of Alexander II (1864) were swept away inchmeal by reactionary legislation under Alexander III (1889-93) and Dorpat became Jurjev in 1893. The enchainment of the peasants to the soil (*adscriptio glebae*) merged into the iron-clad passport prohibitions put upon leaving the country, and this virtual imprisonment within its frontiers is even more rigorously enforced under the Soviet. The spirit of the *artel* or communal guild, like the wooden houses, the Russian baths, the samovar, the troïka, the mediæval costume of the *isvotschik* (cabman), the patriarchal communism, the autocratic bureaucracy, the espionage of *dvornik* (house porter) and secret police, the Asiatic morals of the upper ten, the skill in linguistics, the assimilative power, nearly all these things have persisted under the Soviet on a colossal scale. Apart from primitive folk medicine, Russian medicine up to the time of Pirogov, was in the hands of incoming foreigners. Its greatest developments were military and social: the Military Medical Academy and the immense network of community medicine and communal hygiene attaching to the *zemstvo* development of 1864. Patterned after the medicine of Western Europe and dependent upon it, the scientific medicine of Russia exerted no influence upon the rest of the world prior to the advent of Metchnikov and Pavlov. Pirogov, Metchnikov, Pavlov are its three greatest figures, men who would do honor to any country, typifying the immense latent ability in the Russian people and their absolute freedom from the pretentiousness which is vulgarity.

In 862, Russia emerges upon the stage of European affairs *ex abrupto,* with no apparent relation to the historic or prehistoric past. According to the monkish chronicle of Nestor of Kiev, certain Slavic and Finnish tribes in the forests around Lake Ilmen expelled the Norsemen to whom they had paid tribute (850), but falling out among themselves, sent a deputation to Rus (Sweden) twelve years later, to beckon them back with these words: "Our land is great and fertile but there is no order in it. Come and reign and rule over us." This message, sounding the

note of dependence upon Western Europe for ten centuries, brought in the dynasty of Rurik, whose subjects became Russians. Rurik chose as his headquarters Novgorod, on the Volkhov, destined to become a great commercial centre of the Hanseatic league. Within two centuries, the Norse overlords had established themselves at Kiev on the Dnieper, and by the two great waterways opened to them, invaded Byzantine dominions, married one of their princes to a Byzantine princess, were converted to Christianity and made themselves a great power by intermarriage with the royal families of France, Norway, Poland and Hungary. The Republic of Novgorod expanded from the Baltic to the Ural Mountains. Its government was virtually a republic, with the prince (*Kniaz*) as military leader, while political power was invested in a popular assembly with civilian officials. All this was interrupted by the invasion of the Tatar hordes of Ghengis Khan, who defeated the Russians at Kalka (1224) and held them under tribute for one hundred and fifty years. Meanwhile the principality of Moscow had developed as a military despotism and here Dmitri Donskoi combined with other Russian princes to throw off the Tatar yoke at the battle of Kulikovo (1380). Moscow now became the dominant power and in 1462, Ivan III having thrown off all Tatar influence, constituted himself the autocrat or tzar. His grandson was Ivan the Terrible (1533-84) who destroyed his subjects and subject nobles with a sadism surpassing that of Tiberius Caesar. Ivan's son, a weakling, was supplanted by Boris Godunov (1598-1605) who was in turn, menaced and put out of business by the false Demetrius, an adventurer purporting to be the rightful heir to the throne, whom Boris probably had assassinated. Dissensions following the death of Boris led to the election of Michael Romanov (1613-45), whose dynasty persisted down to the death of Nicholas II (1918).

And what was happening to medicine during these eight centuries?[3] It began, as all primitive medicine does and

[3]The first worthwhile source of the history of Russian medicine is W. M. von Richter: *Geschichte der Medicin in Russland*, 3 vols., 8°, Moscow, 1813-17, which is accurate and reliable as to facts, dates and documentation down

must, with the usual folk superstitions, folk and herbal remedies, which are monotonously and inevitably the same among all early peoples and which still exist among living primitive peoples, Russian or other. The folk remedies and herbals are preserved in some 186 existing manuscripts, which have been duly collated and analyzed. Manuscripts going back to the Kiev and Vlademir periods (11th century A. D.) are known to have existed, but were probably destroyed in the burning of Moscow (1812). Those from the Muscovite principality, dating back to the 16th century, are few in number. After these, there is silence in the records until the time of Tzar Alexei Mikhailovich (1645-76), son and successor of Michael Romanov, when they crop out again in plenty. The earliest known, a Bulgarian MS. called the Siratoslav *Isbornik* (*circa* 1073), is a collection of ethical and philosophic writings, in the midst of which are listed a brief array of foods and drinks, arranged according to the months of the year in which they are best taken. The next MS. deals with remedies employed by Count Stroganov at the court of Ivan the Terrible (1533-84). The Stroganovs, descendants of a rich merchant, were operators of vast mining interests in the Ural Mountains (Perm), and had assisted the Cossacks in the conquest of Siberia (1582). In this barbaric environment, they imported competent European physicians, under whose tutelage they studied medicine. The author of the Stroganov MS. became so proficient in the art of healing, that he was summoned to Ivan's court. The MS. is probably derived from an English medical book, translated by Dr. Kabaischev, an employe of the Stroganovs. The

to the time of Catherine II. The substance of the narrative is Englished in *Brit. & For. Med. Chir. Rev.*, Lond., 1862, XXX, 285-305. A later history, in Russian text is the "Brief Outline" (*Kratkie otcherk*) of L. J. Skorochodoff (Leningrad, 1926), which goes into the Soviet period and is replete with portraits but sometimes deficient in dates. Biographical data are obtainable from the collections of A. A. Polovsov (16 vols. 1896-1912), S. A. Vengerov (6 vols. 1897-1904) and I. V. Vladislairov (1919), from Ricker's Index (13. ed. 1905-12), the official Directory (*Spisok*) of Russian physicians and the Index Catalogue (1.-3. series). Very handy sketches are those in the *Lancet*, Lond., 1897, II, 272-276; 343-374 and by F. Dörbeck: *Arch. f. Gesch. d. Med.*, Leipz., 1909, II, 404-418, translated in *Med. Life*, N. Y., 1923, XXX, 223-234.

next MS. of interest, is an herbal called the Benign Cooling Garden (i. e. Florilegium or Herbal) from Count Uvarov's collection, of date 1534 and printed in 1616. It is a translation of a German compilation, in which some 542 medical plants and 144 mineral remedies are described in alphabetical order, with their Latin, Greek, Arabic and Russian names. This MS. engendered a whole family of "Benign Cooling Herbals." The rest of these MS. herbals and drug-lists are grouped by cities or governments (Novgorod, Pskov, Tversk, Troitska), by names of owners, or reigns of monarchs. They are thus of the same type as the Anglo-Saxon herbals and the empirical MS. formularies investigated by Charles and Dorothea Singer. Most of the earlier Russian MS. were probably destroyed during the period of Tatar invasion and domination (1223-1370).[4] Prior to this event, there were evidences of Greek or Byzantine influences in the representations of bandaging on the Koul-Oba Vase (4th Century B. C.). After the conversion of the people to Christianity (989), the care of the sick, hitherto allocated, like everything else of importance, to the "Elders" of the social group, became, to some extent, a function of the monasteries. The "Elder," be it said in passing, was the tall patriarchal individual of the *Sacre du printemps* or of our own rural and small-town communities, a shade more important than Priam at the Scæan Gate, with the air, which whiskers somehow connote, of being a great emporium of intellect, not unwilling to benefit the entire human race with the net result of his cumulative wisdom and experience. Richter, the medical historian of early Russia, has been ridiculed on all sides for his assertion that the primitive Russians were of such robust physique, so long-lived and blessed with such a healthy climate that they did not need physicians. He is correct, however, in one particular, that the great mass of people never had any medical aid, not

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[4]For these MSS. see, L. F. Zmievev: *Russkiye vrachebniki*, St. Petersburg, 1896. For abstracts from these and other sources, the writer is much indebted to Mme. Regina Plavskiy, Russian translator in the Army Medical Library, Washington, D.C.

even down to the organization of district (*zemstvo*) medicine in 1864 and long after. The Byzantine priests and hermits were the natural friends of the weak and helpless and presently the inevitable secular healers begin to appear, of whom there is abundant tradition. Meanwhile, tzars and nobles began to import medical aid from Western Europe, but all hope of progress vanished with the Tatar invasion and the menace of the Golden Horde. In 1357, Alexei, Metropolitan of the Greek Church, who had developed some skill in ophthalmology, was called to Sarai, the seat of the Golden Horde, to treat the eyes of a Tatar princess. It is also of record that in 1485-90, the physician Leo, a Venetian Jew, was put to death following the routine procedure of the later Middle Ages, for failing to cure foot trouble in a Muscovite prince; and that Anton, a German, met with the same fate at the Tatar court for similar reasons. The effect of these barbarous retributions was to keep foreign physicians away from Russia for a long time thereafter. During the six centuries 1090-1656, the Russian principalities, as Richter tabulates, were exposed to some forty visitations of epidemic diseases and famine, which wiped out the population and for which no medical aid beyond the possibilities of ordinary human decency was at hand. The earliest of these at Kiev (1090), occasioned a mortality of 7000 in 40 days. Famine followed at Novgorod in 1128, with recurrences in 1187, 1215, 1229 and 1230, depopulating all Russia in 1229. The Black Death (1348-51) was equally ruthless and there were recurrences of bubonic plague in various localities down to the middle of the 17th century. Before the end of the 15th century, leprosy and syphilis had appeared, and scurvy in 1552. For all this there was no help of consequence available.

Before the end of the 15th century, printed books had appeared in Germany (1450-55), Italy (1465), Poland (1465), Switzerland (1468), Bohemia (1468), Hungary (1473) and even Turkey (1488), but printing could not get a start in Russia until more than a century later. In 1548,

Ivan the Terrible had attempted to bring printers into Russia and by 1550, a printing press was established at Moscow; but it is said to have been destroyed by copyists of manuscripts, who feared that it might put them out of business. In 1564, Ivan Feodorov and Peter Timofieyev published the first Russian printed book, the *Apostol,* containing the acts of the Apostles and the Epistles, but they were accused of heresy by priests, activated by the jealousy of the copyists, and fled the country to put themselves under the protection of Sigismund III of Poland. A monument has now been erected to the memory of Feodorov. The first Slavonic Bible was printed at Ostrog (Volhynia) in 1581 from another Russian press. By 1600, it had issued 16 printed books. Meanwhile, further attempts had been made by the successive tzars to bring in foreign physicians. In the reign of Vassili III (1505-33) Theophil, a Prussian doctor, was captured by General Saburov in Lithuania and brought to Moscow, while the Greek Marcos came from Constantinople and Nikolai Lujev from Lübeck. During the Tzar's last illness (pyæmia from a suppurating boil in the groin), Theophil and Nikolai were called in. When the Tzar asked the latter if he could cure him, Nikolai replied that being no God, he was not able to raise the dead. The Tzar then turned to his boyars with the verdict: "Nikolai has pronounced my death warrant." Soon after, he was no more. Nikolai was, however, not punished for his blunt honesty, and his colleague Theophil was still active at the court of the successor to the throne, Ivan IV (1533-84), called the Terrible.

In 1537, when Ivan was only seven years old, Hans Schlitte, a German living in Moscow, was authorized by the regency to round up whatever artists, jurists, physicians and mechanics were available in Germany and bring them into Russia. He assembled no less than 120, of whom four were physicians, two operating surgeons, eight surgical dressers, eight barber-surgeons and four apothecaries. But through the machinations of the Hanseatic League and the Livonian Order, these "bearers of culture" were held up

in Lübeck and at Riga, and only a few managed to escape jailing and slip in (Dörbeck). In like manner, Sigismund of Poland tried to induce Queen Elizabeth of England to ignore Russia, but she declined, so that in 1557, two English physicians, Standish and Richard Elmes, were brought in by the Russian ambassador.

Standish is listed in Munk's Rolls as a Cambridge graduate of 1542-71, who had served as proctor of the University in 1551-2, got his M. D. in 1553, and was licensed to practice by the Royal College of Physicians in 1556. He was well received by the Tzar, who dined him several times and gave him 70 roubles, a set of sables and a horse to ride. Elmes, probably an apothecary, incurred the wrath of the "terrible" Tzar for some offence and was returned to England in 1584. From this time on, there was a steady, gradual and ever increasing infiltration of English, German, French and other foreign physicians into Russia, and their fortunes varied. Some were loaded with presents, as ordinarily, and later given their *exequatur* for some misdemeanor. Others, such as Erskine and Lestocq, managed to gain and retain a footing at court, or, like Struensee in Denmark, became influential wire-pullers in affairs of state. Much of the earlier medical history of Russia is cluttered up with accounts of the *res gestae* of these foreign physicians, who, as Dörbeck notes, began to arrive in droves in the years 1616, 1631, 1661 and in the seventies and eighties of the 17th century. Like most European doctors of the Middle Ages and the Renaissance, they existed for the benefit of royalty, the nobility and the hangers on courts and did little or nothing for the people. In view of the continuity of this process of medical immigration, Olearius was impelled to express his conviction that "the Russians have doctors and hold medicine in high esteem"; but down to very recent times, medical graduates have been distrusted by the peasantry as minions of bureaucracy (*tchinovniki*). Of the incomers from England, Dr. Reynolds, who followed Standish, got a salary of 200 roubles, his apothecary, Thomas Carver, who perished in the Moscow fire of 1571, got 100 and the accompanying surgeon 50. Elisaeus Bomel, a Westphalian astrologer, who had been jailed in England for sorcery, got in in 1570, but having plotted against Ivan IV, was burned at the stake and then cast into the Kremlin to die horribly (1581). Bomel was followed by Dr. Robert Jacob (1581), who proposed Lady Mary Hastings as a seventh wife for Ivan the Terrible, but upon the death of the Tzar, returned to England in 1584. Jacob was followed by Dr. Mark Ridley, who was recommended to Boris Godunov by Elizabeth, and remained in Russia four years (1594-8). His successor was Dr. Thomas Willis, who came over in 1599, but was speedily dismissed for apparent negligence in bringing in drugs and instruments. By this time, to send a physician to Russia was regarded as the most suitable present a foreign prince could make to a tzar. Dr. Carbenarius was sent in by the Emperor of Germany, Coster von Rosenburg by the King of Sweden, Engelhard by the Elector of

Brandenburg, Polidamus by Prince Maurice of Orange, Sybelist by the Duke of Holstein, Pauw by Henry of Nassau, Anderson by the King of Denmark, and James I of England sent in Arthur Dee, son of the famous astrologer, who remained in Russia twelve years (1621-34), got 1400 roubles a year, an allowance for rations and forage, a town house of brick, a country seat, and was loaded with costly sables by the Tzar Michael Romanov (1613-14) upon his departure.[5]

The first Russian pharmacy was started by an English apothecary, James Frenchnam (1581), who returned to England in 1583, but brought in more drugs under Boris Godunov in 1602. This was, in fact, the starting point of the *Aptekarsky Prikaz* or Board of Pharmacy (1620), the function of which was to supervise and control the acquisition, study and distribution of drugs. At the *Aptekarsky Prikaz,* the doctors bought their drugs and then sold them to their patients, but it had no control over physicians themselves. In 1678 this center had a personnel of 5 Russian physicians, 2 master apothecaries, and 8 apprentices. By 1800 it had 58 physicians and a number of student apprentices. It was the germ of the *Zemstvo* organization of medical aid for the provinces (1864).

With the accession of the Romanov dynasty, government and the social order became more stabilized, there were fewer wars and popular uprisings, life became more tranquil, the cultural level began to rise imperceptibly and there were some faint signs of aspiration to a better order of things. At the end of the 16th century, the first Russian medical publication was printed, a Polish condensation of a Latin medical treatise ascribed to Buturlin, which was followed by a book on hydrotherapy (*Vodnik*) a translation of the Aristotelian *Problemata* and a mathematical compend containing some anatomical matter. The *Benign Cooling Herbal* (1534) was printed from the MSS. in 1616. From the time of Vladimir (972-1015), there was a crude

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[5]For further details about the foreign physicians, see Richter *passim*, A. Brückner: *Die Aerzte in Russland bis zum Jahre 1800.* St. Petersburg, 1887; and E. G. Baldinger's *Russische physisch-medicinische Litteratur.* Marburg, 1792, a bibliography of the writings of German physicians in Russia from Peter the Great to Catherine II.

expertise in the matter of crime in public courts, the procedure of which was summarized in the Code of Ivan IV. The first medico-legal examination by a physician was made by Maghel in 1537, on the status of a prince who assigned illness as a reason for not appearing at the Muscovite court. The first judicial autopsy was made in 1623. Michael Romanov tried to improve the status of physicians by raising them to the nobility but failed through the native distrust and dislike of foreign doctors and the intolerance of the clergy. In the reign of Michael's son, Alexei Michailovich (1645-76), the Sobor Code of laws (1649), designed for the benefit of the small nobles and middle classes and printed in an edition of 2000 copies (1650), occasioned great bitterness among the boyars, the clergy and the peasantry. The poverty engendered by the extensive circulation and counterfeiting of copper money caused a free silver agitation up to 1663. The raids of the Don Cossacks of the Volga under Stenka Razin (1667-71) gave trouble up to his capture and execution. Alexei was succeeded by the third Romanov, Feodor Alexievich (1672-82) who was followed by the Tzaritsa Sophia (1682-9) during the minority of Peter the Great. Tzar Feodor put up at public expense a hospital, which had a staff consisting of an attending physician and a number of surgeons who conducted a five-year course of instruction for student apprentices. These were taught Latin, anatomy, physiology, pharmacy and the art of prescribing, had to pass an examination to acquire a medical degree and were paid a regular salary during their period of apprenticeship. Prior to this institution, a school for the medical instruction of thirty sons of members of the Tzar's Imperial Guard (Strelitzy Regiment) had been founded in 1654, but this remained a mere idea and was soon forgotten during the wars and political disturbances that followed. In 1672, the *Aptekarsky Prikaz* became the *Aptekarskaia Palata* (Pharmaceutic Chamber).

With the reign of **Peter the Great** (1694-1712), there came a new order of things. As a boy, he was remarkably

apt in studies and later picked up all he could from officers of foreign birth. In pursuance of his plan for building a Russian navy, he travelled in Germany, Holland, England and Austria and not only brought in new ideas, but initiated the cultural interchanges between Russia and the West which went on continuously thereafter. To bring education into Russia, he sought "a window into Europe," made friends with foreigners, organized his state on the European plan and engraved on his private seal the noble motto: "I am of those who seek knowledge and are willing to learn." In connection with his great Northern campaigns (1699-1721), which marked the decline of Sweden and gave Peter his coveted port on the Baltic, he built a new capital, reorganized his army and gave it a real medical service. As a matter of discipline, he transferred the whole aristocracy and landed gentry to life service in the army and navy as enlisted men, not more than one-third of the nobility being admitted to the civil service; while all, whether aristocrat or plebeian, had to begin at the bottom of the scale of fourteen grades or *tchins* and work their way toward the top. Under this bureaucratic arrangement, nobles and commons alike became *tchinovniki* (1722). In 1703, Peter started the Moscow News (*Moskovskia Viedomosti*), the first Russian newspaper, ordered translations of foreign books, including one on etiquette, founded technical and special schools, and in the last year of his life, created the Academy of Sciences (1724) which was opened on January 7, 1726. While in Holland, Peter had apprenticed himself to the art of ship-building and during his European travels, he picked up all the training he could get in medicine and surgery. He is said even to have opened abscesses, tapped dropsies and couched cataracts on his own subjects, sometimes with untoward results.

In Amsterdam, Peter purchased Ruysch's Anatomical Museum and his secret process of injecting cadavers at enormous cost. By an ukase of May 25, 1706, he created the Court (Military) Hospital, the first real hospital and medical school (1707) in Russia. During his reign, ten additional large hospitals, 500 lazarettos and a number of royal drug depots, large and small, were constructed. In 1712-14, the old *Aptekarsky Prikaz* at

Moscow was reorganized as a Pharmaceutic Chancellery (*Aptekarskaya Kantzelaria*). Over this Chancellery, Robert Erskine, a Scotch physician who became *Leibmedik* to the Tzar (1713) and curator of his anatomical cabinet, was called to preside with the title of *Archiater* (1716). In 1711, the budget of the Chancellery was fixed at 50,000 roubles, with a salary list as follows: Archiater 3000 roubles; Leibmedik 600-800 roubles; Leibchirurg 600 roubles; Hofmedik 700 roubles; city physicians and surgeons 400 roubles each; first apothecary 600 roubles; court apothecary 400 roubles; professor of anatomy 800 roubles; professor of natural history 500 roubles. By an ukase of November 2, 1701, Peter had ordered the erection at his own expense of eight private apothecary shops for small town purposes, which were said to have been very successful. To these were added the first public pharmacy in St. Petersburg (April 1, 1706) and two new royal pharmacies at Moscow (1707), one built over its old site in the Kremlin, the other a new building of stone near the Red Gate; with a budget of 20,000 roubles and forty assistants. Similar centres were started at Kazan, Glucov, Riga, and Reval. In 1766-7, an ukase was issued for the improvement of field and garrison pharmacies. In 1706, there was a botanic garden in Moscow and by 1714-19, three in St. Petersburg. In 1718, royal privilege was accorded to run plants for the manufacture of sulphuric and nitric acids. By the Army Regulations of 1716, Peter reorganized its Medical Service as follows: A surgeon general and apothecary general, with two field pharmacies for the whole army (200,000 regulars and 75,000 Cossacks); a physician and staff for every division; a surgeon for every regiment; a feldscher for every company. The Navy Regulations of 1720 made similar provisions for his fleet of 48 warships, 800 smaller craft and 28,000 sailors.

Peter founded the Moscow Hospital (1706) and Medical School (1707), a Hospital for Invalides (St. Petersburg, 1715), an Admiralty or Naval Hospital (1715-16), a Dry Land Hospital (1717, rebuilt 1733), a Military Poorhouse and a Hospital for Foundlings. The hospital fund for these military institutions was deducted from the pay of officers. All his life, Peter took the keenest interest in medicine and was in constant association with his body physicians, Nicholas Bidloo (1702-35) and Robert Erskine (1706-18). Through their influence, he was doubtless led to reprint the Aphorisms of Hippocrates (1742) and Bidloo's Anatomy. Early in his reign, Peter Vladimirovich Postnikov was sent to Italy to study medicine (1692) at royal expense and graduated at Padua in 1694, the first Russian student to acquire a foreign degree. He was followed by Gregory Volkov, who went to Padua in 1698. At the same time, German and Dutch physicians were imported in large numbers for service in the Army and Navy.

All in all, Peter the Great may be regarded as the creator of Russian medicine. In his determined effort to lift his country out of a certain dreary provincialism, he was the

Roosevelt of Russia and, in every sense of the word, a truly great man.

The interval between Peter and Catherine II was a period of relative decadence. For nearly seventy years, Russia was destined to be ruled by women and all these women, not entirely excepting the great Catherine herself, were under the sway of favorites. Catherine I (1725-7), the widow of Peter the Great, was dominated by Menshikov; Anna Ivanovna (1730-40), daughter of the short-lived Ivan V, was infatuated with Biron (Büren), who filled the court with foreigners; Anna Leopoldovna (1741) was guided by Münich and Ostermann; and Elizabeth Petrovna (1741-61), the daughter of Peter the Great, under the sway of Lestocq, made a clean sweep of all the favorites, but was secretly married to Prince Rasumovski (of the Beethoven quartets) and was tagged by Frederick the Great with an epithet which cost him dear[6] in coping with his "world of enemies." Elizabeth was in reality, a woman of remarkable good looks, but fat, indolent, sensual, good-natured, "fond of horse-flesh and low company" often feline and cruel to other women, but otherwise gracious enough, and probably not as black as painted. The effect of all this succession of trivial tzaritsas was to create a reactionary bureaucracy which, however favorable to the arts, did little for science, medicine or social welfare. In the Seven Years War, the Russian infantry gave a good account of itself, defeating Frederick's platoons at Gross-Jaegersdorf (1757) and Kunersdorf (1759), but the frame

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[6]The old soldier's growl about *Pinfâme catin du Nord.* "Friedrich's wit," says Carlyle (XIII, 8) "cost him dear; him, and half a million others still dearer, twenty years hence." Yet, in spite of the very favorable view expressed by Sir Charles Hanbury Williams and other Englishmen who had audiences with this Tzaritsa, Carlyle follows his hero as usual: "An indolent, orthodox, plump creature . . . not an ounce of nun's flesh in her composition, said the wits" (XII, 8); and again: "Mainly a mass of esurient oil, with alkali on the back of alkali poured in . . . till by pouring and stirring, they get her to a state of soap and froth" (XVII, 1). Apart from the acrimony and prurient interest excited by Freudian repressions, we now judge of the *fredaines* of great dames of the past according to the dictum of the old dramatist: "She's never lewd that is accounted great"—the program handed to young Catherine II, when she came to the Russian court.

hospitals erected by Peter the Great had long since collapsed and even before the reign of Tzar Paul, what remained was more pitiful than the bogus clapboard villages of Potemkin. Not a single hospital of 200 bed capacity was to be found in the realm, nor had any of them wards in which the patients could be protected from wind and rain. The Naval Hospital at Cronstadt was fully destroyed and the Army Hospital at Moscow so little adequate to its purpose that a report of January 1, 1797 records finding two patients in a bed. Half the patients in a military hospital or a marching command died automatically from disease and neglect. Many of the civil service reforms in Peter's Table of Tchins were annulled, so that the nobility regained certain privileges at the expense of the Army and the peasantry. The University of Moscow was founded in 1755. In 1761, Elizabeth again sent ten Russians to Holland to study medicine and some of these, such as Pogoretski, Jagelski, Timkovski and Fialkovski became prominent in very creditable ways.

The most important figure in the history of Russian science in the 18th century was:

Michael Vasilievich **Lomonosov** (1711-65), one of those men of universal genius who might have been the regenerator of his country had the time been ripe for his message. The son of a poor fisherman, he memorized what rude primers he could get hold of and ran away to Moscow, concealed in a wagonload of fish, without a kopek in his pocket. Through the charity of a monk, he got into school, where he did so well that he was passed on to the Academies at Kiev (1735) and St. Petersburg (1737) whence he was sent to Marburg for three years. Upon his return, he was forcibly enlisted as a soldier in Frederick's Army, but managed to get back to St. Petersburg in 1741, where he became adjunct professor of chemistry in the University (1742). In 1751, the Tzaritsa Elizabeth made him full professor and, in 1760, rector of the University. Flattered by an ode, Catherine II made him a councilor of state (1764). He was an able chemist and mathematician, a grammarian and a poet, who wrote so well that he is styled "the father of Russian literature." He wrote a chronology and a history of Russia, a Russian grammar, an epic on Peter the Great, two tragedies, an epistle on the utility of glass and made contributions to chemistry, metallurgy and physics which were highly praised by the mathematician Euler. His letter to Shuvalov on the conservation of Russia stresses the great need for physicians and drug stores, "of which there are none, so that many who should be alive are dead." But all this

fell upon sterile ground and Lomonosov was not to be appreciated until a century later.

Catherine II (1762-96) patterned herself after Elizabeth and even surpassed her as the *grande amoureuse* of history. The reign of Catherine II lasted 34 years and was marked by a great show of theoretic liberalism, based upon her sympathy with Montesquieu, Diderot and the other political and social doctrinaires of France. This was found to work well in the development of literature, the fine arts and the ornamental phases of Western European civilization, but was speedily abandoned when she found her ideals conflicting with those of the upper classes who supported her. A great commission of 652 members of all classes of society was convened to canvass social problems, the vast regional units established by Peter the Great were broken up into governments and districts, the vast properties of the church were secularized as government domain, education for the better classes was forwarded and even emancipation of the serfs was considered, but this was all vain show and ended in smoke. Catherine's parade of liberalism was like the clapboard phantom villages which Potemkin ran up along the Dnieper to delude his sovereign during her triumphal progress into the Crimea. Under Catherine, Russia acquired the Crimea and the Baltic Sea provinces and such annexations went on unimpeded up to the Russo-Japanese War of 1905. In Panin, Catherine had an astute foreign minister and in Suvorov, a general who never lost a battle. The rebellion of Pugachev, a Cossack outlaw who tried to duplicate the success of the False Demetrius (1773), was put down after two years fighting. Disturbances of this kind became the signal for harsh reactionary measures. Catherine's reign was thus rather a cultural awakening, a phase of 18th century "enlightenment," than a true progression toward economic and social betterment. In this period flourished Lomonosov, Derzhavin, the historian Stcherbakov and other writers of note. Catherine was liberal toward her flatterers and generous in her medical endowments. It was part of her program of "enlightenment" to establish social service institutions,

hospitals, homes for the feeble minded and a "Medical Commission" to coöperate with provincial governors in securing physicians and drug stores for the cities. At the instance of Voltaire, she and the grand duke Paul were inoculated against small pox by Thomas Dimsdale, who got $60,000, a pension for life ($2500) and the title of Baron for his trouble. In 1763, the St. Petersburg branch of the *Aptekarsky Prikaz* was converted into a Medical College, which, in 1835, became the famous Military Medical Academy. To Moscow, Catherine gave the Catherine, Galitzin and Pavlovski Hospitals and a foundling asylum (1764); to St. Petersburg, another foundling asylum (1770), an insane asylum (1776), a "Secret" hospital for venereal diseases (1763) and the Obukhovski Hospital (1784). In Catherine's reign, Shafonski published his account of the plague of 1769 and Ambodik introduced the use of obstetric forceps. In 1795, General Suvorov turned into the old Zaluski Library (opened to the public in 1747), some 260,000 volumes and 10,000 MSS., captured as booty in wars, and thus started the Royal Public Library of St. Petersburg. Hundreds of valuable private collections and all the books and pamphlets printed annually in Russia were added to this great library, which now numbers nearly 5,000,000 printed items and 3,310,100 MSS.

Catherine's son and successor Paul (1796-1801) whom she kept in leading strings for over forty years, was timid, inexperienced, bigoted, narrow-minded, militaristic, hence incapable of the specious play of liberalism which had made Catherine popular, and so was doomed beforehand to assassination. Apart from the military successes of Suvorov, his reign had nothing to its credit, indeed was so tyrannical that it was called the "Reign of Terror." Nevertheless, under Paul, some improvements in medical administration were instituted in the provincial governments. The Collegium Medicum (1763) became the Medico-Chirurgical Academy (1798, opened 1800) and the old Moscow Hospital was ordered to be rebuilt. The first president of the Medico-Chirurgical Academy (1804-35) was Sir James Wylie (1768-1854), an Aberdeen graduate, who entered

the Russian Army Service as senior surgeon to the Eletsky Regiment (1790), and became physician to Tzar Paul (1798-1801). The Academy became the Military Medical Academy in 1835. In 1808, Wylie became Inspector General of the Army Medical Board of Health, served through the campaign of 1812-13, and was first director (1812-36) of the Medical Department of the Ministry of War (organized 1811). In 1891, a Clinical Hospital was constructed from funds left by him and was named after him. Wylie wrote on yellow fever (1805), scabies (1811), plague (1829), cholera (1831), conjunctivitis (1835), published a *Pharmacopœia Castrensis Ruthenica* (1808), and did much to improve the status of Russian hospitals.

With the accession of Alexander I (1801-25), who was confronted by the full swing of the Napoleonic wars, Russia assumed a rôle of domination in European affairs never realized before or after. This was due to the character and ability of the Tzar, who, from Tilsit to Waterloo, was the ablest political opponent of Napoleon and the chief agency in his downfall. Like his great grandmother, Alexander was a liberal at heart and sensible enough to utilize his counsellors, Adam Zartoryski, Stroganov and Speranski. He repealed the tyrannic ukase power of the senate and gained universal approbation through his cheerful, courteous exterior, his self-possession ("the Charming Sphinx"), and his general good nature. But the events of 1812 left their mark upon him and with the Holy Alliance (1815), he became suspicious, distrustful and negative, if not reactionary, in regard to the aspirations of the masses. The result was the formation of secret societies, which came into being about 1816, and the "Decembrist" revolt of troops, which followed hard upon the death of the Tzar (1825). His successor, Nicholas I (1825-55) was a blunt, unimaginative soldier, merciless as Arakcheyev (his father's martinet) with subalterns and given to terrorizing his subjects by glaring them down in the street. He crushed the Decembrist and Polish insurrections with the utmost rigor, created a censorship of the press and a secret police system,

held up travel by expensive passports and alienated, or even exiled, the nobility by a despotic bureaucratic regime. He increased his territory by his Persian and Turkish campaigns (1826-9) and died during the Crimean War (1855).

During the half century following Catherine's reign, many changes had come to pass in European medicine. France, through such eminent masters as Bichat, Laennec, Louis, Bretonneau, Bouillaud, Corvisart, Andral, Rayer, Ricord, Pinel, Alibert, Cruveilhier, Magendie, Flourens and Poiseuille, had virtually created much of modern medicine and under Louis and Chomel were trained Holmes, Gerhard and others who did so much to make medicine a going concern in our Eastern states. Great Britain had such great clinical pathologists as Bright, Addison and Hodgkin, Graves, Stokes, Colles, Robert Adams and Corrigan. German medicine, following the Revolution of 1848, had given over the romantic doctrines of the Natural Philosophy School, had crossed the Rubicon to gain the land of *Sachlichkeit* (reality) and already gloried in two new stars of the first magnitude, Virchow and Helmholtz. In Russia, things were moving at a much slower pace. As early as 1721, Blumentrost, then Archiater, had put through the Senate a drastic law against quacks, yet 50 years later, the apothecary shops in St. Petersburg were receiving prescriptions from unknown "physicians," who had never been examined for the *venia practicandi*. The hospitals of Peter's reign had fallen into decay, indeed the over-crowding and squalor in the larger hospitals were as bad as in the Hôtel Dieu. So shocking were the conditions in the Moscow Hospital that the Tzar Paul ordered its reconstruction (1797), a new hospital for 1280 patients being completed in 1802. Even so, half the patients in hospital died and in a marching command of 300 recruits, 150 died *en route* and the rest died in the hospital after reaching their destination. The incoming foreign physicians were either too inexperienced or too old to take up private practice and those who succeeded were often plain barber surgeons. By 1804, there were five university medical faculties in Rus-

sia, viz., that of the old Moscow University (1755), the Medico-Chirurgical Academy (1798), that of the University of Dorpat, founded by Gustavus Adolphus in 1632 and reorganized in 1802, and those of Kharkov (1804) and Kazan (1804). The University of St. Petersburg was opened in 1819. But, apart from the Military Medical Academy (1835), at which most of the greater medical men of Russia were educated, the medical teaching at these institutions was poor and feeble in quality, even in the comparatively late period when Pirogov and Botkin were students (1850-55). Of the Moscow teaching, Botkin relates that most of the professors had completed their medical education abroad and merely read off, in perfunctory fashion, lectures about what they had learned, lectures written sometimes ten or fifteen years before. Of practical training, apart from rare bouts of dissecting and a few examinations of patients, there was none. "Our future" says Botkin, "was ruined by our teachers, who conveyed knowledge in the form of categorical verities, without giving us any incentive to original investigation whatever." Ower, professor of internal medicine, was so busy with his extensive practice that he seldom gave more than 6-8 lectures in an 8 months' course; while his assistant, as also Toporov, professor of special pathology and therapy, looked upon percussion and auscultation as a "swindle." Pirogov records that, during his entire period of medical study at Moscow, he never once dissected a single subject. The deltoid muscle was demonstrated by tying a strip of cloth to the proper points of attachment on the skeleton. Lectures on chemistry, surgery, pathology were delivered in Latin from obsolete 18th century text-books. There was no objective teaching whatever. While a few, such as the anatomist Loder, the zoölogist Fischer and the botanist Hoffman, were worthy of their calling, this state of affairs persisted from the coronation of Alexander II until the death of Nicholas I (1855) and after. In Germany, Pirogov found such surgeons as Graefe, Dieffenbach and Rust to be wofully deficient in anatomy, and although Ower had a pathological museum, and a fine collection existed in

the Moscow University, there was no chair of pathology until 1849, when the subject began to be forwarded under the inspiration of Virchow. The truth is that the Russian people, exhausted by the Napoleonic Wars (1812-15) and cowed by the tyrannies of Nicholas I, lacked the enthusiasm and interest necessary for the advancement of science. The most important medical men of the period before the introduction of organized district (*zemstvo*) medicine were:

The great embryologist Carl Ernst **von Baer** (1792-1876) who was born in the Baltic Sea provinces (Esthonia), published his monograph on the development of animals in the Memoirs of the St. Petersburg Academy (1828-34), is accredited to the Russians as a native son and, indeed, devoted most of his life (1834-76) to investigating the anthropology and physical geography of the country.

The reformers Constantin Ivanovich **Stchepin** (1728-1800), who introduced mineral waters and induced the government to abolish physical punishment of school children, but coming under the ban of persecution, took to drink and died of alcoholism; and Peter **Podgoretzky**, who on account of his critiques of the deficiencies in medical education, was given a post in Siberia to get rid of him. After his departure, the Medical School of Moscow University began to go into decline. In later years, it became a seat of literary and philosophic culture, while science thrived best at the University of St. Petersburg (1819) and the Military Medical Academy (1835).

Ivan Petrovich **Venssovich** (1769-1811) was called to the first chair of physiology in the University of Moscow and published a treatise on the subject. The first professor of theoretic medicine in Moscow University was Semen Hirassiniovich **Zybelin** (1765) who, in his work on the constitution of the body (1777), advanced strange views as to its chemical make-up, notably that disease is a "cacochemic" process. Matvei **Mudrov**, the leading Moscow physician of his time, mentioned in Tolstoi's *War and Peace*, published the first Russian Manual of Field Surgery, lectured on military hygiene and strove for the autonomy of Russian medicine. He was a Brunonian up to 1824, after that a follower of Broussais. Ustin **Diakovsky** (1784-1841), who held the Moscow chair of theoretical medicine (1831-5), made a classification of diseases (*Systema morborum*), did important work on cholera and first strove to free Russian physicians from the thraldom of foreign influences by developing novel theories of his own. In these, he displayed originality of a bizarre species but little common sense, for instance in his odd views of material and "dynamic" lines of treatment. These *dynamidia* covered such absurdities as encouraging the filthy habits of the insane, when they were irritable, or the view of anger as psychic (promoting hepatic activity and the secretion of bile) and organic (due to hepatic irritation and injurious to the organ).

Lebedjev adjunct professor of theoretic medicine, advanced equally fantastic views of the structure and chemical composition of the fœtal and adult body in his "General Anthropopathology" (1835) albeit with some glimmering of the biochemic theory of irritation, the biogenetic law of Haeckel and Virchow's theory of inflammation (attraction).

Alexander Ivanovich **Ower** (1804-64) who held the chair of clinical therapeutics after Mudrov, tried to improve himself in pathological anatomy and made a collection of specimens.

Justus Christian **Loder** (1753-1832) of Riga, was director of the Moscow Hospital (1813-17) and lectured on anatomy up to 1831. He published an Anatomical Atlas (1797-1803), several anatomical treatises and an introduction to physical anthropology. His bust and his collections are in the Anatomical Institute he founded.

Gregory Ivanovich **Sokolski** (1807-86), who held the chair of special pathology (1835-48), was the most remarkable of the Moscow internists. His book on diseases of the chest introduced percussion and auscultation and is notable for its sound rational views of things. "It is easier to rationalize and indulge flights of fancy than to investigate the physical properties of things. Inexperienced youth applauds a chimæra and the aim of the theoretical pundit is attained."

Fedor Ivanovich **Inozemtzev** (1802-69), son of a Persian prisoner, was another passionate protagonist of the autonomy of Russian medicine, a fanatical adherent of solidist pathology and of the view that diseases had changed in character since 1840 (*genius morborum*). Formerly they were of inflammatory character, requiring venesection, purgatives and cooling remedies; now irritation of the nervous system, manifesting itself as gastritis (Broussais) predominated, and for this Inosemtzev gave a standard specific, compounded of ammonia and tartar emetic, which was mixed in large quantities by the nurses. His main titles to fame are his pupil Botkin, the *Moscow Medical Journal* (*Moskovskii vrachebnü Journal*) which he founded, and the Society of Russian Physicians (*Obshestvo russkich vrachei*) in Moscow, which he organized.

Plainly the internal medicine of the period did not amount to much, but better beginnings were made in surgery at the Military Medical Academy of St. Petersburg (1835). The development was forwarded by the exclusively military character of this institution and above all through its magnificent medical library, then the largest of its kind in Europe. The first professor of special pathology and therapy in the Academy was Conrad Frederick **Uden**, who started a journal of dietetics, which was opposed by the clergy and finally appeared under Count Zuboff's protection as the *Petersburgskoye Vrachevniy Viedomosti* (1792-4) the first Russian medical periodical.

Karl **Seidlitz** (1799-1885) of Reval, was a great reformer of medical teaching, developed microscopy, clinical chemistry and post-mortem examinations, employed palpation and auscultation and left an early account of

Weil's disease. He was an original thinker on the nature of phthisis, prescribed baths in typhoid fever and employed quinine in malaria.

The pioneer of surgical work in the Academy was Ivan Feodorovich **Busch** (1771-1843) who published the first Russian manual of surgery (1807) and had as pupils Pelikan, Savenko, Salomon, Gaevski and Buyalski. Salomon was the first in Russia to ligate the internal iliac artery and to perform lithotripsy.

Physiology was developed in the Academy by **Zagorsky** and pathology by Nicholas **Zdekauer** (1815-97) who founded the first cholera commission in 1866. The study of chemistry and physics was inaugurated in the Academy by Nikolai Nikolaievich **Zinin** (1812-80) who early sensed the future importance of these subjects, while Alexander **Dubovitsky** (1815-68) made equally important efforts toward substituting a scientific staff for a hollow bureaucracy.

Alexander II (1855-81) came to the throne at the end of the Crimean War, which had humiliated his country and exhausted its resources. Russia began to recede from the dominant position she had taken with reference to continental European affairs and Alexander bent his mind upon internal and social problems. He was a liberal, who surrounded himself with liberal ministers and through his great achievement, the emancipation of the serfs, the abolition of the corrupt legal system and the creation of the great network of district assembly or *zemstvo* government, he was known as the Liberator. By 1871, Reutern, his minister of finance, had put the country on a sound financial basis, but the Second Polish insurrection (1863-4), the attempted assassination of the Tzar in 1866, the acquisition of new Asiatic dominions, the building of Vladivostok, the activities of Herzen and Bakunin, the rise of the Nihilists and the war with Turkey (1877-8) made for reactionary measures, such as compulsory military service (1874), and the Tzar was assassinated by a hand grenade on March 2, 1881. In this period, Russian literature rose to a great height, and Russian music was already beginning to convey its charm through the work of Modeste Moussorgsky (*Boris Godunov*), Glinka and Anton Rubinstein. In the reign of Nicholas I, the world had come to know the poets Pushkin and Lermontov, the fabulist Krilov, the novelist Gogol, and the historian Karam-

sin, but now came Turgeniev, Tolstoi, Nekrasov and the great chemist Mendelejev. The novelists, in particular, threw much light on the social (actual) status of Russian medicine up to 1864. The problem of supplying medical aid to such a vast population had proved insoluble and came to be regarded as negligible. A Russian village could not then and can not even now maintain a doctor. Such devices as the half-way doctor (*feldscher*), the flying corps of oculists and other specialists, were inadequate fugitive expedients and 99 per cent of the population went through life without any conception or experience of medical aid. The Army alone was well supplied with physicians and the main development of Russian medicine in Pirogov's day was military. When a doctor did appear in a Russian village he was besieged on all sides, everywhere and nowhere, sought by all, hence seen by few, had no time to make anything but a superficial diagnosis, never saw his patients again, and, as happened with the "visit and a bottle" plan of the English panel system, his efforts resulted in lost motion and waste of time. He could do good only when accompanied by an ambulance, with *feldschers* and a drug chest. A physician settling permanently in a rural district left it in disgust, since the peasants regarded him as a meddlesome, intrusive clerk or bureaucrat, whose duties, such as the commitment of the insane, constituted a public nuisance. The few hospitals, which existed here and there, were now in horrible condition as to appointments and sanitation, and no peasant who entered one ever came back. Only conceited, restless pseudo-physicians, attracted by the fictitious responsibility and the semblance of great activity ("the fictitious majesty of a wading waterfowl"), could put up with such a life. All these traits were deftly noted and subtly conveyed by such men of genius as Pushkin, Lermontov and Gogol, who made these half-baked physicians ridiculous as ignorant *tchinovniki.*

It was reasoned that the cause of all this was serfdom and satrapy, since the serfs were regarded as an index of wealth, to be replaced by breeding after devastating epi-

demics, whence the only way to give them medical aid was to take it to them by administrative methods. The Tzar therefore emancipated the serfs (1861), did away with the corrupt courts and established territorial self government all over Russia, by means of electoral assemblies in the thirty-four government provinces and their component districts, with provisions for local administrative control of medical aid. This was accomplished by abolition of the old Pharmaceutic Chancelleries of Peter's time, by the taking over of 335 hospitals (11,309 beds) from 359 districts of the thirty-four governments, with 53 smaller hospitals (3,448 beds), all in wretched condition, and by an attempt to replace them by better institutions, with better and more competent personnel. This was a large order, covering an area of 2,845,420 square kilometers, with a population of 66,545,635 inhabitants, and looked well on paper. Even Pirogov believed that "*Zemstvo* medicine ought to combat the ignorance of the masses and change their way of looking at things." It was found that the budget allotted was nowise sufficient to rebuild or to repair the 388 hospitals and even the business of taking them over occupied 5 years (1865-70). Meanwhile, the *zemstvo* authorities turned to the task of reorganizing means of combatting epidemic diseases, building upon the faulty procedure of the Committees of Public Health (organized 1852). This lost itself in red tape and paper work, while the peasants preserved a stolid silence about disease foci in order to dodge the high cost of drugs, treatment and other contributions levied upon them, so that the district physician usually arrived to find the epidemic over. Yet by 1890, the *Zemstvo* had 1422 medical centers in 359 districts, with 1068 hospitals (26,571 beds) and 414 dispensaries, a total personnel of 1805 physicians, 8046 assistants and 2454 midwives. In 1897, 46,195 patients had been cared for in hospital, 1,380,889 ambulant patients had been treated in the dispensaries, 836,418 visits had been paid to 13,178 patients, 6466 labor cases had been handled in hospital, 2873 at home, and 49,344 persons vaccinated in the Moscow Government alone. This will give some idea of the

vast scope of *zemstvo* medicine, its development in 32 years time,[7] its difficulties in coping with huge, prolific populations, scattered over enormous areas and its relation to the grand scale organization of social medicine attempted by the Soviet, which obviously derives from it.

The physicians who did most for this great administrative network of *zemstvo* medicine were first and foremost:

Evgrav Alexievich **Osipov** (1841-1904), who devoted his whole life to this work. During 1875-95 he was director of the Sanitary Bureau, organized its Statistical Division (1896), analyzed the statistical data of the Moscow Government and worked out the general program for increasing the number of hospitals, creating dispensaries and triangulating by topographic studies the whole vast area under *zemstvo* control. Dmitri Nikolayevich **Zbhankov** (1853-) published a bibliography of the literature (1890), the first general revision of the data (1894), reports on the medical topography of the Kostroma, Riazan and Smolensk governments and other activities. Ivan Ivanovich **Molleson** (1842-1920) gave up rural practice to organize the first Sanitary Commission at Perm (1871) and to become its first public health officer. Thus backed by government, he carried on his missionary work at Novgorod (1872), Perm (1873-81), Astrachan (1881), Iroit (1882), Perm (1888), Saratov (1889), Tambov (1896), Kaluga (1906) and Voronezh (1911-20) acting as a peripatetic public health officer all over Russia for nearly fifty years. He was, however, almost alone in his endeavors.

Fedor F. **Erisman** (1861-), a Swiss, who settled in St. Petersburg to practice ophthalmology (1869), gave up his practice to devote himself to such public health activities as school hygiene, the inspection of free night-lodgings, factories and food-products. He was director of disinfection during the Turkish War (1877-8) and established the first Hygienic Laboratory in Moscow (1889).

Fedor P. **Haas** (1780-1853) a Viennese, was the John Howard of Russia. He became a prison physician and devoted his life to the welfare of prisoners. He insisted that prisoners should not be sent to Siberia in chains and was known as the "Holy Doctor." Memorable pioneer work was done by the Medical Society of Kazan (1868) which, after 1870, at the instance of its president, A. V. Petrov, devoted itself almost exclusively to public health activities for seven years (1870-77). But in 1881 was organized the Medical Society in Memory of Pirogov, which took over these activities at Pan-Russian Congresses held at St. Petersburg in 1885, 1889 and 1893, at Moscow in 1887 and 1891, at Kiev (1896) and at Kazan (1899), and at the annual meetings of the local societies. At the fifteenth

[7]For the official account of *zemstvo* medicine, see E. Ossipov, I. Povov & P. Kourkine: *La médecine du Zemstvo en Russie.* Moscow, 1900.

Moscow-Petersburg Congress (1898), A. V. Molkov was appointed director of a Commission to disseminate hygienic literature among the people. In the famine year (1899), dining rooms, dairies, asylums for child welfare were organized and, in 1900, a Tuberculosis Commission was created under Prof. Scharvinsky. The Pirogov Congress also played a leading rôle in fighting cholera and malaria. Its literary organ was the *Annals of Legal Medicine and Public Hygiene*, edited by A. V. Lovtsov (1865-72) and subsequently appearing under other titles.

But the greatest and earliest pioneer in social welfare activities was Nikolai Ivanovich **Pirogov** (1810-81), who entered the University of Moscow at the age of 14, graduated 8 years later with a dissertation on ligation of the abdominal aorta (1832) and completed his medical education at Berlin and Göttingen, where he was disgusted with the ignorance and indifference of Rust, the elder Graefe and Dieffenbach with regard to anatomy. Conrad von Langenbeck was, in his opinion, the only German surgeon who knew anything of the subject. Returning to Russia in 1835, Pirogov taught for 5 years at Dorpat and was then appointed professor of surgery in the Military Medical Academy (1840). Here he was active up to the Crimean War (1854-5), in which he introduced female nurses for the wounded and served 14 months around Sebastopol. Prior to this event, he had rendered field service to the Caucasus (1847), was, with Syme of Edinburgh, the first European surgeon to employ ether anæsthesia (1847), made 800 post mortems of cholera victims (1848), imported Hyrtl's pupil, Gruber, from Vienna to teach anatomy (1846). In 1851-54, Pirogov published his great atlas of topographic anatomy, based upon frozen sections in three planes and his method of complete osteoplastic amputation of the foot (1854). Pirogov was the life and soul of the Military Medical Academy, which he lifted to a high plane of efficiency through his work in the reorganization of army hospitals and his introduction of dissecting and of pathological anatomy as a discipline (11,000 post-mortem sections). His treatise on military surgery was published in 1864. He was an advocate of greater freedom and higher education for women and, in the face of bureau-

cratic opposition, did his utmost for the advancement of medical education in Russia. He retired from activity a broken man, but emerged reluctantly to report on the Franco-Prussian (1870) and Russo-Turkish campaigns (1877). His memoirs[8] reveal the inevitable Slavic tendency to mysticism. He is regarded by the Russians as the greatest figure in their medical history.

Wenzeslaus Leopold **Gruber** (1814-90) a Bohemian anatomist whom Pirogov imported in 1846 to teach the subject in the Academy, did not join the staff until Pirogov's retirement in 1855, when he became professor of practical anatomy and subsequently director of the Anatomical Institute and Museum, constructed according to his plans in 1871. During the forty-five years of his activity in Russia, he did an enormous amount of research work on human and comparative anatomy, notably on the bursæ, the fasciæ, the muscular and vascular systems, the larynx, the male mammary gland and on abnormities in man which are normal in certain lower animals. He wrote and lectured in German, assembled a remarkable anatomical museum (1000 crania), admitted women students to the dissecting room and was in close relation with Botkin and Setchenov as a reformer of medical education. His most brilliant pupil was Peter Franzovich **Lesshaft** (1839-1909) who published several manuals and text books, was a pioneer in the advancement of physical training (1886-8) and child study (1890-94), and described Lesshaft's space.

Other Russian anatomists of note were Dmitri Nikolayevich **Zernov** (1842-) professor at Moscow, author of an elaborate treatise on descriptive anatomy (1890-91) and inventor of an encephalometer (1892); and Yermolaev, professor at Kazan.

In histology, the outstanding Russian authorities were: Alexander Ivanovich **Babukhin** (1835-91), who investigated the histology of the nervous system, the electric organs of fishes and comparative electrophysiology; N. M. **Jakulovich**, who was awarded the prize of the Academy of Medicine (Paris) for his histological researches in 1853; Alexander Stanislovich **Dogiel** and Philip Vassilievich **Ovsiannikov** (1827-), both of whom did remarkable work on the comparative histology of the central nervous system; and Liveriy Osipovich **Darkschevich** (1858-) who discovered the nucleus in the Sylvian aqueduct which goes by his name. Dmitri Leonidovich **Romanovsky** (1861-) devised the well known stain for malarial plasmodia (1891).

The most eminent Russian embryologist was Alexander Onufrievich **Kovalevsky,** who showed the identity of the

[8] N. I. Pirogov: *Lebensfragen*, Stuttgart, J. G. Cotta, 1894.

early stages of Amphioxus and the Tunicates, the constancy of the gastrula stage in all animal embryos and the relation of the medullary tube to the archenteron.

Ivan Michaelovich **Setchenov** (1825-1905) was the father of Russian physiology and neurology. At the same time, he resembled Huxley in his efforts to popularize physiology among the working classes (Pretischensky Lectures). His elementary manual (1898), like Huxley's little book, had an enormous success. Although of very humble birth, he came to be looked up to as an authority, whose word was law, all over Russia. He is remarkable for his discovery of the inhibitory centers of spinal reflexes in the medulla and cord (1865) and his experiments on the physiology of the central nervous system (with Paschutin, 1865). He was succeeded in the Academy by

Elias **Cyon** (1843-) who in Carl Ludwig's laboratory, discovered the depressor nerve of the heart and the *nervi erigentes* of the blood vessels and the vasomotor function of the splanchnic nerves (with Ludwig, 1866) for which he received the *prix Montyon* (1867). He also investigated the vasomotor nerves and reflexes (1868), the rate of blood flow in the veins (1871), uterine contractions (1874), the function of the semicircular canals (1874-6), the formation of space-perceptions (1877-8) and the innervation of the thyroid gland (1897). He published a text-book of physiology (1873), a book on electrotherapy (1873), which was awarded the gold medal of the Academy of Sciences (Paris), and a manual of physiological methods and vivisection (with Atlas, 1876). In 1872, Cyon was appointed professor ordinarius in the St. Petersburg Academy, which he was called upon to reorganize, but became a political reactionary with regard to Nihilistic students and although ennobled by Alexander II, he was forced to leave Russia to settle in Claude Bernard's laboratory, where he became a naturalized Frenchman. Cyon's greatest pupil was Pavlov.

Another Ludwig pupil was the Lithuanian, Jan **Dogiel** (1830-) with whom Ludwig invented the *Stromuhr* (1867) and discovered the fact that the first heart sound is partly produced by cardiac muscle (1868). In 1869, Dogiel became professor of pharmacology in the University of Kazan, where he continued his researches on the circulation, the salivary nerves (1893), the nerve fibres (1897) and the histology of the retina and ureter. Among the pupils of Cyon was Ivan Romanovich **Tarchanov** (1848-1909), who discovered the psycho-galvanic reflexes (1890), wrote on the psycho-motor centres (1879), hypnotism (1886), venoms (1888), colds (1899) and (with Poehl) a book on organotherapy (1906). He employed the telephone in electrophysiology, investigated the physiology of sleep, the automatic

movements of beheaded animals, the effect of music on the organism and described the physiological peculiarities of those who can alter their pulse-rate at will (1885). The telephone was also employed by Nikolai Igorevich Vvedensky (1844-) who is memorable for his work on nerve-blocking, and nerve stimulation (Wedensky effect, 1884).

Of the physiological chemists, Marcel Nencki (1847-1901) of Kalisz, Poland, was not only one of the outstanding pioneers in biochemistry, but also, with Panum, one of the earliest and ablest investigators of the bacterial chemistry of putrefaction.

A medical graduate of Berlin (1870) he made himself a master of chemical technique under Bayer at the *Gewerbeakademie* (Berlin) and taught his subject at Berne for twenty years (1871-91), when he was called to direct the laboratory of the Oldenburg Institute of Experimental Medicine at St. Petersburg (1891), where he remained up to his death from cancer. As a pure chemist, Nencki first isolated the guanamines as melamines and various ketones of use in the manufacture of aniline dyes. He investigated the physiological oxidation of benzine and its derivatives and the fate of esters in the alimentary tract, obtaining phenyl salicylate or salol. In bacteriology, he improved the technique of anaerobiosis, isolated indol as a product of bacterial protein degradation in the intestine, showed that hydrolysis is the first stage of protein dissociation, tabulated the decomposition products of putrefaction, showed that bacteria are not necessary to protein digestion, studied the effect of intestinal bacteria on carbohydrates and demonstrated that lactic acid can be produced from sugar in the absence of oxygen. He discovered urorosein (1882), parahæmoglobin (1885), salol (1886), pyalin (1886), did remarkable work on the blood pigments (1884-6), the purins and proteids (1891), and demonstrated that ammonia is eliminated from protein digestion in the alimentary tract, passing as ammonium carbamate to the liver, where it is converted into non-toxic urea. Nencki was a man of amiable but eccentric disposition, of whom many bizarre anecdotes were related by Naunyn and his other associates. His *Opera omnia* were published in 1904.

Alexander Jakovlyovich **Danilevsky** (1839-) was the first to attempt to separate the pancreatic ferments (under Kühne, 1862) and did good work on isodynamic foodstuffs (1885). His brother Vassili (1852) wrote on the parasitology of the blood (1888-9) and the physiological action of electricity at a distance (1902). L. P. Borodin, composer of *Prince Igor*, devised a method of estimating urea. A. N. **Bach**, remarkable for his work on blood ferments, has devised a method of estimating them from a single cubic millimeter of blood.

The leading Russian pharmacologists were Dragendorff, Tikhomirov, Pel (or Poehl) and Kravkov.

George **Dragendorff** (1836-98) of **Rostock**, held the chair at Dorpat for nearly thirty years and wrote on toxicology (1868), forensic chemistry (1871), chemical analysis of plants (1882) and an unfinished masterpiece on medicinal plants of all peoples and periods (1898), which is of great historic value.

Vladimir Andreyevich **Tichomirov** (1841-) investigated the trichinæ (1880) and wrote a memorable treatise on pharmacognosy (1888-90).

Alexander Vassilievich von **Poehl** (1850-98) investigated spurred rye and ergot (1873-83), jaborandi (1880), peptone (1882), overstimulation of nerves as a cause of auto-intoxication (1902) and with Tarchanov, published a treatise on rational organotherapy (1906). In 1891, he extracted spermin (isolated by Philip Schreiner, 1870) from the bovine testes and under the spell of Brown-Séquard, introduced it into practice as a rejuvenant. He ultimately published a big book on the subject (1898-9).

Nikolai Pavlovich **Kravkov** (1865-1924) a brilliant pupil of Setchenov and Schmiedeberg, became professor of pharmacology in the Military Medical Academy in 1899. His early work covered such varied themes as the biochemistry of carbohydrates, the distribution of glycogen by fungi, experimental amyloidosis (1894), experimental arteriosclerosis, the endotoxin of cholera, yohimbin, diastase, the effect of antipyrin on nitrogenous metabolism and the basal metabolism in poisoning. The publication of his great work on "The Bases of Pharmacology" drew attention to his extraordinary experiments on isolated organs perfused in nutrient media. Kravkov produced inflammation by irritating an excised rabbit's ear perfused with decinormal salt solution. On excised fingers, preserved for months in nutrient media, he demonstrated the growth of hair and nails under perfusion or the production of perspiration by raising the temperature or by infusion of pilocarpine. He performed similar experiments on the organs of patients who had died from different diseases, and obtained normal endocrine secretions from excised ductless glands by perfusion. He isolated pancreotoxin, an effective insulin preparation. His method of obtaining endocrine extracts by perfusion with blood is now employed in Europe.

The Moscow professor, G. P. Sacharov, has borne eloquent testimony to the activating effect of Virchow's teaching upon the development of pathology and experimental medicine in Russia.[9] Up to 1850-60, as we have seen, anatomical teaching in Russia was a farce, and of pathology there was no sign. Dissecting, as routine training, had no existence until Pirogov imported Gruber, and without dissecting, there could be no adequate training for operative surgery. Clinical medicine was in a bad way

[9] G. P. Sacharov: *Arch. f. path. Anat.*, Berlin, 1921, CCXXXV, 329-378.

until a number of Russians, who had come under Virchow's spell, began to filter into practice. One of the earliest of these was Botkin, who testifies that he found Virchow's somewhat intricate lectures diffuse, bewildering and boresome, a never ending stream of minutiæ, difficult to assimilate, for the Russian student, brought up on rigid dogma, could not dissociate hypothesis from matter of fact, nor even make the innumerable facts function along rewarding lines of thought. Such was common experience, for at this time, Virchow's actual teaching was accessible only to a select circle around the post-mortem table. But what Virchow did for the medical world at large was to throw down the false idols of the schools and to inculcate a true scientific method, whereby problems were to be isolated, approached, attacked and invested. To this matter of selecting the most advantageous peep-hole into the ways of nature, Virchow undoubtedly had one important clue, and this clue (his cell-theory), apart from the stimulating catalysis of his very active mind, was to be an important fructifier in the development of Russian pathology and internal medicine. Before Virchow's time, many medical problems had been of the kind ticketed by Ostwald as "illusory problems" (*Scheinprobleme*), and in consequence, certain scientific proofs became "whirligig proofs," and the outcome un-science (*Scheinwissenschaft*).

Before 1849, the University of Moscow possessed a few collections of pathological specimens (in the clinics), but there was no chair of pathology. Up to 1859, Polunin, the first professor of the subject, taught the old humoral pathology. In the winter semester of 1859-60, he posted a course of 20 lectures on Virchow's cellular pathology and had drawings, copied from Virchow's book, hung up in his auditorium. About the same time, Klob, Rokitansky's assistant in Vienna, posted on his blackboard the following notice: "From Thursday on, lectures on pathological anatomy will be delivered according to the cell doctrine of Virchow." By 1860, the influence of Virchow was decisive and ineluctable, a definite catalysis, of which the final product in Russia was Metchnikov.

One of the earliest of the Virchow pupils was Michael Matvieyevich **Rudnov** (1837-79), who began with serous tubercular formations (1863), worked with Virchow and Kühne on the morphology and chemistry of amyloid degeneration (1865), published a volume of pathological researches on the cholera epidemic of 1866, introduced a new microchemical reagent, studied the epithelium of the frog and wrote an important memoir on replantation and transplantation of bone (1880).

Vladimir Platonovich **Krilov** (1841-1906), professor at Kharkov, investigated pulmonary syphilis (1870), but devoted his main efforts to the pathology of the constitution. Apart from his oral lectures, he did not publish his findings, which are buried in his post-mortem protocols and is in consequence, little known. He classified connective tissue as areolar (reticular), fibrillar and fascicular, and from this viewpoint developed his doctrine of the fibromatous constitution (fibromatosis) of strong muscular framework and massive skeleton; the lipomatous constitution (lipomatosis), with proliferation of areolar and fatty tissue; the gracile constitution, with long fragile bones, flaccid conical heart and thin walled vessels; and the lymphatic or catarrhal constitution, with small heart, narrow vessels, excessive follicular proliferation and atony of the intestinal tract. These four types connote peculiar predispositions to disease.

Sergiei Michailovich **Lukyanov** (1855-), professor at Warsaw, was in the Virchow trend in his twenty lectures on the general pathology of the cell (1891), investigated functional disturbances of the separate compartments of the heart (1883) and published monographs on the general pathology of the vascular system (1893) and of digestion (1897). In 1886, he started a laboratory in Warsaw and in 1894, became director of the Institute of Experimental Medicine at St. Petersburg.

Michael Nikeforovich **Nikiforov** (1858-) investigated granulation tissue (1890), embolism, preparation of blood-films and wrote a pathological atlas (1895) and a massive treatise on pathology (1900-1923).

The influence of Virchow on Russian descriptive pathology is further perceptible in the swarm of investigations on the degenerative processes, embolism, thrombosis, leucocytosis, transudates, cloudy swelling and atheroma, notably those of **Abrikossov** on fatty metamorphosis, chalky deposits and predisposition to disease; E. F. **Lyubimov** (1841) on colloid degeneration and the pathology of pseudarthrosis (1867); Ivan Feodorovich **Klein** on thrombosis (1864), spondylolisthetic pelvis (1870) and disseminated sclerosis (1882); **Saltikov** on chalky deposits, inflammation, atheroma and heart disease; Valerian **Podvissotki** (1822-) on regeneration of glandular tissue in wounds (1886) and partial regeneration of the liver in mammals (1886). With the foundation of the Institute of Experimental Medicine by Prince A. P. Oldenburg in 1890, and its literary organ, the *Archives of Biologic Science* (*Archiv biologicheskich naukh*, 1892), a definite impetus was given to experimentation. Outstanding in this field were: Victor Vassilievich **Paschutin** (1845-1901), who made his mark by his in-

vestigations on carbohydrate degenerations, infarctions, diabetes, morphologic changes in hunger, his lectures on general pathology (1878-81) and his great treatise on general and experimental pathology (1885-97).

Vladimir Valerianovich **Podvisotski** (1857-1913) investigated experimental regeneration of the liver (1886), parasitic sporozoa (1893), the reserve forces of the organism (1894), coccidia, and with I. G. Savchenko (1862-), the rôle of sporozoa in malignant tumors (1892-94).

The leading Russian clinicians of the 19th century were Botkin and Zacharyin.

Sergiei Petrovich **Botkin** (1832-89), son of a Moscow tea-merchant, studied medicine against the grain, having felt a greater inclination for mathematics. Graduating at Moscow in 1855, he served in the Crimean War under Pirogov and was put in charge of the typhus and typhoid wards, since his bad eyesight prevented him from following surgery. After four years study in Europe under Virchow, Traube and Claude Bernard, he was appointed professor of internal medicine at the Military Medical Academy upon his return (1860). He became the foremost consultant in St. Petersburg and was appointed court physician in 1870, but during the last decade of his life, was forbidden the court on account of dubious political activities of which his wife (born Princess Obolinska) was falsely suspected. A diagnosis he made of a mild case of plague in his clinic, when the disease was ravaging the lower reaches of the Volga (1878), set another alarmist storm about Botkin's ears, and although he was sustained by public opinion, he never recovered from the chagrin. He died of angina pectoris at Mentone on Christmas Eve, 1889. In his honor, a barrack hospital and a medical journal were named after him. Botkin was a clinician of the type of Skoda, studying the disease rather than the patient, attaching most importance to a scientific diagnosis confirmed by a postmortem, and tending toward therapeutic nihilism. He gloried in brilliant diagnoses, but in his lectures, displayed a distinct tendency toward general pathology. He loved to elucidate at length his various theories as to the causation of disease, notably the bacterial causation of gallstones, the infectious nature of jaundice (Botkin's disease) and leukæmia. This was characteristic of the St. Petersburg school and of Botkin's pupils, notably Vinogradov at Kazan, who declined to lecture on such a concrete theme as croupous pneumonia, leaving his students to flounder in the clinics as best they could. Botkin was the author of a treatise on clinical medicine (1867-8) which was translated into French and German, of books on fever and heart disease, also translated, and was editor of *Clinical Archives of Internal Medicine* (1875-87). His posthumous writings include "Letters from Bulgaria" (1894), a Clinique of Internal Medicine (1899) and Clinical Lectures (1899).

Vyacheslav Avksentyevich **Manassein** (1841-1901), Botkin's clinical assistant (1867-9) and best pupil, wrote on inanition (1869), the dimensions

of the red blood corpuscles under different conditions (1872), experimental fever, lectures on genèral therapy (1879), introduced nutritive enemata, was regarded as an authority on malaria, and was founder and editor of *Vrach* (1880-1901), the leading Russian medical weekly. About this time, the Russian graduating dissertations came to be of value and of these, no less than 120 were turned out by Manassein's pupils, apart from three volumes of *Arbeiten* from his laboratory (1876-9).

Gregory Antonovich **Zacharyin** (1829-1894), Botkin's Moscow rival, based his practice upon clinical observation, as opposed to experiment, both in diagnosis and treatment, with a single eye to getting the patient well. He brought the clinical examination and interrogation of the patient up to a fine art, and some of his feats in diagnosis, such as in floating kidney, gallstones (pain on pressure) and the differentiation of incipient and terminal œdemata in pneumonia (with reference to blood-letting), have become famous. As a therapist, he brought order into the chaos of indications for blood-letting, standardized the use of calomel (1889) and utilized mineral waters with remarkable skill. So successful was he in results, that the French clinician Huchard was sent to Russia in 1888 to study his methods. Zacharyin's Clinical Lectures (1889-94) passed through five editions and were translated into German, French and English.

Zacharyin held the chair of clinical medicine in the University of Moscow for thirty-five years (1860-1895) and had the most lucrative consulting practice in all Russia. His clientèle was wealthy, his fees high, and his professional manner with patients brusque, eccentric and exacting. He attended Alexander III in his last illness, and so bitter were his disputes with Leyden and so strange his actions that he was indirectly charged with the Tzar's death. His house was torn down, his furniture burned in the street, he was dropped from the medical societies and resigned his chair although cordially greeted by the students. But Nicholas II forgave him and presented him a diamond snuff box.

Eduard Georg Eduardovich **Eichwald** (1837-89) who entered the Military Medical Academy in 1864 and was driven out of it by Botkin's domineering attitude, was one of the best lecturers on general and specific therapy of his time. His Sunday lectures covered such themes as critical reviews of all lines of treatment and animal magnetism. In 1885, a large fund was left in his name by the Grand Duchess Helena Pavlovna for the construction of a Clinical Institute, now known as the Institute for Post-Graduate Medical Training.

Of the Russian pediatrists,

Karl **Rauchfuss** (1835-1915), of St. Petersburg, was the leader in the earlier period. He superintended the construction of the Prince Peter of Oldenburg Hospital for Children (1867-9), of which he became director and head physician, and also built the St. Vladimir Children's Hospital in Moscow (1874-6). In 1876 he became pediatrist to the Tzar's family

and made many notable contributions to his subject, notably a history of children's hospitals (1877).

Nils Feodorovich **Filatov** (1847-1902), professor of pediatrics in the Moscow Faculty (1891-1902), was director of the Chludov Children's Hospital (1891), which he made one of the most going pediatric clinics in the world through his engaging lectures. He was the first president of the Moscow Pediatric Society (1892) and author of lectures on infectious diseases of childhood (1885-7), in which he described "fourth disease" as "scarlatiniform rubella" (1887) before Dukes (1900) and Koplik's spots (1895) before Koplik (1898). His Pediatric Semiology is highly esteemed.

Dmitri Alexandrovich **Sokolov** (1861) published a clinic of pleurisy in children (1906) and an instructive album of photographs of sick children (1914). Ivan Vissarovich **Troitsky** (1854-) has made valuable contributions to the history of pediatrics, of which he has also published a text book (1892-3.) Infantile digestion is considered in the writings of Nikolai Petrovich **Gundobin** (1860-1908) and in the many student dissertations of the Pávlov School.

In neurology and psychiatry,

Alexiei Jakovlevich **Kozhevnikov** (1836-1902), professor of neurology in the University of Moscow (1884-1902), was the first Russian physician to be called to a chair of this specialty. He opened his clinics and the Kozhevnikov Neurological Museum in 1892, and also had a hand in founding two large lunatic asylums in the city. He wrote on all aspects of his subject and described the mild continuous or partial epilepsy which goes by his name (1893), also lathyrism (1894). His pupil, Vladimir Karlovich **Roth** (1848-) of Orel became professor extraordinarius at Moscow in 1894, wrote on glioma of the spinal cord (1887-90), published a large, illustrated work on muscular atrophy (1895) and invented a thermo-æsthesiometer (1889).

Vladimir Michailovich **Bechterev** (1857-), professor at Kazan (1885) and St. Petersburg (1893), is remarkable for his experimental work on the semicircular canals (1882) and cortical localization of motor functions (1887), his classification of mental diseases (1891), his use of suspension in diseases of the spinal cord (1893), his study of pathways of conduction in the brain and cord (1893), his neurological anatomy (1901) and his many writings on nervous diseases, psychiatry, psychology, suggestion, space-perception and allied subjects. He discovered many unknown bundles and nuclei in the brain and cord, described spinal arthropathy (1892) and noted several unusual symptoms.

Sergiei Sergieyevich **Korsakov** (1853-1900), described the polyneuritic psychosis or alcoholic paraplegia (1887) known as Korsakov's insanity, and wrote the best Russian text book on psychiatry (1893).

Ivan Alexandrovich **Sikorsky** (1845-) published a notable work on the physiognomy of the insane (1887-93) and Nikolai Nikolayevich

Bazhenov (1857-) a history of the Moscow Madhouse, with many illustrations (1909).

Prominent among the syphilographers and sexologists was Benjamin Michailovich **Tarnovsky** (1837-1906), who wrote on syphilitic aphasia (1870), sexual aberrations (1886), prostitution (1888) and suchlike themes.

The outstanding military surgeons after Pirogov were:

Nikolai Alexandrovich **Velyaminov** (1855-), who founded the first Russian surgical journal (*Chirurgicheskii Vestnik*, 1885), classified diseases of the joints (1908), published a clinique of syphilis of the joints (1910), wrote on thyroid hyperfunction and dysfunction, and theorized on hysteria as an endocrine disorder. He organized the Red Cross during the Russo-Japanese war (1904) and was surgical inspector on the staff of the Grand Duke Nicholas in 1914.

Robert Robertovich **Vreden** (1867-) was prominent on the staff of the Military Medical Academy and excelled in otology and aural surgery. He described aspergillosis of the tympanic membrane (1867-8), analyzed 80 post-mortem sections of otitis media in the new born (1868), introduced camphor naphtol injections in surgical tuberculosis (1910), discovered the gelatinous substance in the inferior auditory canal and published a field manual of military surgery (1911).

Peter Ivanovich **Dyakonov** (1855-1908) of Orel, participated in the Russo-Turkish War (1877-8) as an orderly, but got into political difficulties while completing his course at the Academy and was assigned to the Orlov Government as territorial physician (1879). Returning in 1883, he became Health Officer of Moscow and the first professor of surgery in the University out of territorial ranks. He initiated the annual congresses of Russian surgeons (1888), published books on the statistics of blindness (1888), death from chloroform (1890), antiseptic wound treatment (1895), and was editor of *Khirurgia* (Moscow, 1897-1908.)

Antisepsis was introduced into Russia (1868) by Paul Petrovich **Pelechin** (1842-).

Vladimir Dmitrievich **Vladimirov** (1837-1903) introduced the method of osteoplastic resection of the tarsus (1872) afterward perfected by Mikulicz (1881); and Sergiei Petrovich **Kolomnin** (1842-86), the treatment of disease by ignipuncture.

Alexander Alexievich **Bobrov** (1850-1904) introduced an osteoplastic operation for spina bifida (1892) and a method of operative treatment of hydatids of the liver (1896-8).

Nikolai Vassilievich **Skliffosovsky** (1836-1904) was a pioneer in antisepsis, a successful operator in gastrostomy for œsophageal stenosis, ligation of the jugular vein in goitre and inventor of the Russian clamp for suturing bones in the operative treatment of false joints.

The gynæcologist Vladimir Feodorovich **Snegirev** (1847-) introduced

vaporization of the uterus (1898), and wrote on uterine hæmorrhage (1885), and clinical lectures on diseases of women (1899).

Ovariotomy was first performed in Russia (1862) by Anton Yakovlevich **Krassovski** (1823-98), who had 128 operations to his credit (1884), and published a treatise on operative obstetrics (1885).

Alexiei Andreyevich **Vvedensky** (1856-1900), at Tomsk, worked on such details as lithotrity in children (1887), calculus in women (1893), and the topography of the female pelvis (1893).

Alexander III (1881-94) was a good-natured man of strong, stocky physique, sluggish disposition and quiet, bourgeois tastes, surrounded by reactionary ministers, such as Pobedonostsev, Plehve and Sipiagin. In consequence, the reform program of Alexander II and Loris Melikov was abandoned and the policies of the reign were conservative and reactionary. Alexander III managed to keep his people out of war, however, and the general stability and tranquility of his reign earned him the just title of "Peace Maker." The main features of his foreign policy were a perceptible turning away from Germany after the Congress of Berlin, a vague *entente* with France and an attempt to Russify Finland and the Baltic Sea Provinces. The unsatisfactory financial situation following the Russo-Turkish war (1877-8) was relieved by a high protective tariff and the standardization of the gold rouble. Development of the factory system gave employment to idle peasants and the construction of the Trans-Siberian and Trans-Caspian Railways encouraged many to take up free land and settle in Siberia and Central Asia. To help out the agrarian crises, the government opened land-banks for peasants and landed proprietors alike.

Where formerly Russian medicine was mainly an offshoot or tributary of Western European medicine, it now began to exert a definite, sometimes decisive effect upon the world at large. Like Von Baer, such expatriates as the Berlin surgeon Ernst von Bergmann (1836-), Alexander Schmidt (fibrin ferment, 1862), Elie von Cyon, Oscar Minkowski (pancreatic diabetes, 1889) and Constantin von Monakow (cerebral localization, 1891-2, red nucleus, 1910), were all of them born within the territory

of old Russia and the barriers of language and of distance have been overcome in the case of such important findings as the Eck fistula, the Wedensky effect, the Kernig test or the Stroganov method. The anæsthetic effect of cocaine was noted by Vassili Konstantinovich Anrep (1879-84) before Koller, the "fourth disease" was described by Filatov before Dukes, and Pirogov was almost as forward in the use of ether as the surgeons in the Massachusetts General Hospital. There is a Russian by-word to the effect that Russians are always a few minutes too late. But mere questions of priority dwindle into insignificance before the work of such men as Metchnikov, Pavlov, Haffkine or Besredka, who have been very real benefactors of mankind at large.

Elie **Metchnikov** (1845-1916), son of a spendthrift Russian guardsman and a Jewish mother, was born on his father's estate at Passanovka in the Kharkov Government. In his childhood, he developed a taste for microscopy, which established his bent. As a professional biologist, he was destined to do for the solidist theory of immunity what the chemist Pasteur and the histologist Ehrlich did for its chemical and humoral aspects.

Metchnikov was an enthusiast of high-strung, supersensitive, overweening nature, whose extremist views and tendencies kept him in constant hot water. Graduating at Kharkov, he became professor of zoölogy in the University of Odessa and subsequently director of its Bacteriological Institute, but the disappointments of his life and his disgust with the reactionary tyrannies of his period were such that he could not adjust himself. He twice attempted suicide, once (following the death of his first wife) with an overdose of morphine, and again, when he resigned his Odessa chair, with an auto-inoculation of relapsing fever. On October 15, 1888, he entered the Pasteur Institute where he was to experience such happiness and serenity in the prosecution of scientific research that he became the world's greatest optimist. His discoveries were all of capital importance. His observation of phagocytosis in the larvæ of Daphnia,

while in Messina (1884), led to a new view of immunity, to vaccinotherapy and to the doctrine of the reticulo-endolethial system, which he mapped out as to locus and function in connection with his studies on inflammation (1892) and immunity (1901). His demonstration that bacteriolysis can take place in *vitro* (1895), that the higher apes can be inoculated with syphilis (1903-4) and that lactic acid can counteract auto-intoxication by changing the bacterial content of the intestine, were equally productive of far-reaching results. His brief for optimism and longevity (1907) is very like Scriabine's belief that the music of the future will possess potencies sufficient for the regeneration of mankind. In the history of Russian science, Metchnikov has only one peer, the great chemist Mendeleyev.

Among the other Russian bacteriologists associated with the Pasteur Institute were:

Nikolai Feodorovich **Gamaleia,** who discovered the bacillus of chicken cholera (1888) and did work on experimental cholera in animals (1899); Waldemar **Haffkine** (1860-93) who was assistant to Pasteur (1889-93) and the great pioneer of preventive inoculation against cholera (1893-) and bubonic plague (1897-1908) in India; and Alexander **Besredka** (1870-) of Odessa, who discovered antianaphylaxis or desensitization (1907), introduced sensitized vaccines (1913), preventive inoculation against phthisis by virulent bovine bacillus vaccines (B. C. G. 1921-7) and developed the theory of local solidist immunity within the cells and tissues, without the production or intervention of antibodies (1925).

In Ivan Petrovich **Pavlov** (1849-) of Ryazan, Russia gained a physiologist who resembles Carl Ludwig in his fatherly capacity to inspire pupils and found a school.[10]

As a lad, Pavlov was athletic, gamesome, ambidextrous and of remarkable tenacity of purpose. At fifteen, he became attracted to physiology by reading G. H. Lewes' book and in 1870, entered the University of St. Petersburg to study medicine under Mendeleyev, Buttlerov and Elie von Cyon, whose assistant he became. Under Cyon's influence he majored in physiology and won a gold medal for his first investigation (with Afanassiev) on the pancreatic nerves. During 1875-9, he passed on to the Military

[10]For this phase, see the interesting biographical sketch in Pavlov's lecture on *Conditioned Reflexes,* New York, 1928, 11-31, by his pupil, Dr. W. H. Gantt, who worked in the Leningrad Laboratory during 1925-8.

Medical Academy and completed his doctor dissertation in 1883. During 1884-6, he worked under Ludwig (Leipzig) and Heidenhain (Breslau). In 1890 he was elected professor of pharmacology in the Military Medical Academy where, in spite of bouts with the despotic director, Paschutin, he remained until 1924. In 1891, the first laboratory of physiological surgery was constructed under his direction in the Oldenburg Institute of Experimental Medicine, of which he had become director (1890). In 1888, Pavlov discovered the secretory nerves of the pancreas, in 1889 the phenomena of "sham feeding" or "psychic secretion" and in 1897, he published his investigations on the digestive glands, for which he received the Nobel Prize (1904). Up to this date, he had encountered virulent opposition on account of the novelty of his findings, which were likened to those of animal trainers. Pavlov's success in expefimentation was partly due to his extraordinary skill and ambidexterity in operating on animals, including his method of producing a permanent pancreatic fistula and his use of the Eck fistula (1877). His books on the work of the Digestive Glands (1897), and on Conditioned Reflexes (1926) summarized his own researches.

Apart from these, Pavlov has created a school of Russian physiologists not unlike the pupils of Ludwig and Sir Michael Foster. Many of these have done remarkable work.

Outstanding among the Pavlov pupils are Mme. Schumova Simanovskaia, who assisted him in his method of excluding the stomach to produce a gastric fistula (1889); Chischin, who discovered the effect of different kinds of food upon psychic secretion (1894); Dolinsky, who discovered the effect of irritating the duodenal mucosa with acids in stimulating pancreatic secretion (1895); Chepovalnikov, who discovered the solvent action of pancreatic juice upon proteins when stimulated by intestinal juices or their hormone enterokinase (1899); Volkovich, who discovered the inhibitory effect of fat upon the flow of gastric juice. The graduating dissertations of Russian students on the physiology of digestion make a brilliant showing. Since 1903, Pavlov has worked mainly on the conditional reflexes, and here again his pupils have produced over 200 papers, many of which were written since the war. In 1907, Krasnogorsky discovered conditional reflexes in infants, an experiment which became basic in behaviorist psychology.

Prominent among the later Pavlov pupils are Gleb Vasilievich **Anrep** (1891-), who has worked in methæmoglobin (1880), antagonism of vasodilator and vasoconstrictor nerves (1894) and the coronary circulation (1927-9); Leon A. **Orbeli** who has demonstrated the effects of sympathetic nerve fibres on skeletal muscle with A. G. **Ginetsinsky** (1922-3) and on the spinal reflexes (1925);

A. D. **Speransky** who has shown the effects of freezing upon the brain and the paths of ingress of antitoxins into it (1928).

In 1916, a *canard* asserting the death of Pavlov gained credence, whence he enjoyed the rare distinction of ascertaining the world's opinion of his merits in many flattering obituary notices. As sometimes happens, however, with a well organized plan of research, his work has been carried on steadily, by himself and pupils, through the period of the Revolution and beyond it.

F. H. GARRISON.

THE CONTROL OF CHRONIC DISEASES

GEORGE H. BIGELOW

Commissioner of Public Health, State of Massachusetts

(Hermann Michael Biggs Memorial Lecture, delivered at The New York Academy of Medicine, May 7, 1931.)

For a health officer to be asked to deliver an address dedicated to the memory of Hermann Biggs is at once a great compliment and a great challenge. What can one of lesser clay say at all worthily in the presence of such a fine professional memory? And yet is there not some hope that a fleeting flicker of his light may be caught and reflected for a moment, though then instantly again lost? The health officer, particularly embarrassed in such presence, reads Lemuel Shattuck's almost prophetic writings of what the public health had in store, much of which is still out of our grasp. But Biggs added to such keen vision the great gift of accomplishment. Surely in the presence of such a memory any health officer must weigh well his audacity and clumsy incompetence.

The growing challenge of chronic disease with all its social, economic and medical implications would have appealed to Dr. Biggs as a problem worthy of his mettle. In fact, Colonel Russell tells me that some twelve years ago Dr. Biggs told him that he had just this problem in mind. For most, it is still unquestionably the province of the private physician, the general hospital and, below the economic dead-line, the public welfare agency. Why should a health officer have any thoughts about chronic disease? Let public health stick to its last of environmental control, communicable disease control, child hygiene, with a little dabbling in maternal hygiene, and mental hygiene if you must, but do leave the rest of acute disease and chronic disease decently for private health. Such thinking (and I

must say I have sympathy with it) is likely to go on and decry the inroads of organized society and government into all privacy today. With the threat of television in the bathroom and loud speakers on airplanes, birth control and more autopsies, requiring statements of why doctors prescribe liquor, and pictures of the mattresses and bedrooms where our socially conspicuous retire, there is little enough that is private from the cradle to the grave. Let health officials stick to their sewage and pesthouses and let us have a little private disease decently and alone.

In spite of all this, consider for a moment whether service to chronic disease is a sound province of government or not, irrespective of whether this province, if it exists, is that of the health officer, the institution director, the department of public welfare, or the board of licensure for cosmetists. For after all to the man in the street it makes little personal difference what department spends his dollar once he has kissed it good-bye. It is the effectiveness of the personnel of the department giving a particular service, rather than the departmental title, that insures reasonable return on investment. But to the general theory of government. In chronic disease, fortunately, there is no need of invoking police power as in communicable disease, polluted water, milk, and the like; so that one need not stand on one's head and whistle through one's ear while vituperating on the protection of the individual against the group and vice versa. (As a matter of fact, the individual rights enthusiast is often the least considerate of his family and his neighbor.) I cannot conceive of any compulsion exerted on anyone to make use of any service offered in the chronic disease field. Of course, a barrage of information as to the proper use of any resources must be laid down, but psychological compulsion has not yet roused the resentment of physical compulsion and the advertising brethren would not tolerate its prohibition.

The question then is whether resources for chronic disease, to be used optionally by the public, should properly be furnished by government irrespective of the economics

of the recipient. (I think there is no serious question but that the paupered chronic should be cared for, but primarily for his pauperism rather than his chronicity.) But what of the non-pauper chronic? Of course, theories of government are as varied as are fat reducing diets and most of them are no more effective. There is the lantern-jawed business man who wants profits without taxation, and who feels that only such "essential" services should be given by government as can not or will not be given by private initiative "effectively." That isn't as good as it sounds. With his private resources this man is likely to have a pretty limited conception of what services are "essential." Then, too, he doesn't state how bad a private service can be before he feels it is not given "effectively," particularly if he be a stockholder.

At the other end of the spectrum is the unhygienic blatherskite who thinks that the only reason soap is manufactured is that it may furnish containers on which he may stand and orate. He has nothing to tax, so let the state furnish everything from soup to nuts, particularly the latter so that he may not feel lonesome! As with everything, the wise theory of government is somewhere between.

But as with any middle course, your opinion and mine as to the exact location of the "middle" depends upon our particular political experience, the degree to which the theory of universal education has failed in our particular case, and whether or not at the moment we have or have not had a good breakfast. Also, where such fluctuants as economics and sociology are concerned, what is paternalism today may be rock-ribbed conservatism tomorrow. Public water supplies in Massachusetts were at first administered by private water companies. Then the "best citizens" probably strained their cardio-vascular systems at the suggestion of governmental encroachment in this field, as they do today at the notion of price fixing of farm produce. Yet now, with ninety-six per cent of our people served by public supplies, we find only a few small private companies persisting and the sooner they are taken over

by the people the better. They are an anachronism! If this profound change in attitude in this particular field has taken place in a few generations, why not in others? With such wide diversity of opinion in a field of such perplexing variables a theory will probably not help us. If the fact is that the people, who get what they want in our form of government if enough of them want it long enough—if our people demand that government serve chronic disease, chronic disease will be so served for better or worse. But should we, who aim to appear thoughtful, aid and abet such a demand if and when it comes, and in what direction should we guide it? That the tree falls cannot be doubted nor long prevented. That it falls where it will, precludes conscious anticipation by the woodsman. To prognosticate future fallings from the heights of private initiative to the depths of organized social effort may be possible by reviewing certain trends.

Not so long ago society was largely sharply stratified. The few had everything and a little more, the many had what was left and liked it. The churches gave certain succor, and an occasional aristocrat with uninhibited inhibitions gave largesse, but these were so unusual that they were made a matter of permanent record. (If the usual were made public record, Mr. Ford would probably think even less of history than he does.) Then democracy swept parts of the world. Social stratification became obscured. Neighbors, for better or worse, became keepers. Social sensitiveness developed and brought with it a sense of community responsibility. Individual social needs were met in an increasingly organized way by the community. The question was no longer whether these were a community responsibility but rather how far and how much. It was a question of extent rather than kind.

In the field of public health the first organized efforts were against the importation of communicable disease. Then bacteriology opened the flood gates of environmental control. Much that is still demanded of health officers in this field is a carry-over from the mentally free and easy

days of spontaneous generation when putrescible organic matter was the cause of all human ills. Randall says that the most permanent thing in man's civilization is ideas and this is evidenced by the persistent public demand that the unæsthetic be controlled in the name of health. But even so, through the control of water, milk, and specific living vectors of disease, great strides have been made. In vast stretches of the world our control knowledge in this field has not been put to work, and there are blind spots where more knowledge is needed. Here resources of government must be concentrated on adding to and applying such knowledge; and expenditures in other more intriguing, perhaps, but less specific fields must be delayed. For us, however, with improved communicable disease resources, particularly where active immunization is possible, the great era of personal hygiene has burst, and anything that bursts is usually not entirely under control, if at all.

Perhaps the greatest efforts in personal hygiene have been directed toward the tuberculous and the children; for the former perhaps because there was nothing specific to offer and tuberculosis was shockingly frequent, and for the latter largely because the young animal rouses the most sentiment. It is perhaps purely fortuitous that the younger the animal the greater the return on the expenditure for its hygiene. There, hygienic efforts have largely been built around detecting as early as possible defects, physical (as teeth, tonsils or posture), habitual (as rest, recreation, nutrition or mental attitudes), or immunological (as a susceptibility to diphtheria or smallpox or other diseases for that matter which our present knowledge gives us no proved effective method of rectifying) and the subsequent correction of these detected defects. Vast sums are being spent in this way and vaster effort and discrimination must be exercised in appraising returns that the expenditures may become more and more specific. In our growing appreciation of the well-being of the child our attention has been given, not too effectively as yet, to the pregnant woman, and it is to be regretted that we can-

not retroact on the grandparents and great-grandparents. Other than that, we have left the adults almost completely alone except for the rather gun-shot advice as to annual visits to their doctors which they have in some numbers made, frequently to their profound disillusionment. Should now the health officer acknowledge as his province the whole field of chronic disease and its control, he would with one sweep include not only all adults (and there are many such physically, though fewer mentally) because of the vast pre-clinical ramification, but also almost the whole field of medicine. But before laughing that off, let us see how the field of medicine has fared over the years.

Up to two or three generations ago the people looked for healing to the priests, the mystics, the fanatics, the senile, and the demented. The entire appeal was to faith. With the advent of science we would replace faith with fact and in the presence of the psychological trauma inseparable from serious disease, fact is a pretty thin substitute. (You may say that this is recognized by psychiatry, but if that is so it seems to be far from any practical large scale application as yet.) All this emotional wateriness of the scientific gruel may, in part, account for the recent articulateness of the general dissatisfaction with things medical which we hear on every hand. Hardly a self-respecting editor in the country today would dare to offer his paper for serious consideration without at least one medical billingsgate between its covers. Also, this may account for the apparently increasing profit in medical mysticism as dished up by the crystal gazers, the absent treaters, and the back wallopers. (Incidentally we should thank Heaven it is the back they wallop. Just think if the barrage of their attentions were concentrated on the abdomens of the country.) Where we have specific therapy we may perhaps hope that universal education will develop a people that in general will submit, but for all other diseases our doctors must practice the art of medicine and in this they must compete in the open field with the charlatan.

But beyond this, with the widening of our field of knowl-

edge we have built up a vast array of machinery and special skills and judgments which has enormously diffused the care of the sick and increased its costliness. One black bag, one silk hat, and one pair of whiskers, while enough for eighty per cent or more of the sick, is colossally inadequate for the remainder. This is causing dissatisfaction as to both the quality and price of medical service as generally available and out of an appreciation of this dissatisfaction has sprung the Committee on the Costs of Medical Care which is accumulating relevant data with amazing skill. But also out of this dissatisfaction have come a lot of things more specific than any committee. Whole schemes of medical service by government, industry, labor groups, lodges, colleges, semi-public and private medical groups have been organized on vast or diminutive scales. Some like them and some do not. Some want more and some less. But the multi-varied schemes that have been perpetrated are simplicity itself compared with the glorious projects that we fortunately know not of but hear of almost daily. The most limited intellect feels quite capable of diagnosing the trouble with medical service today and of offering an unequivocal solution. The least fecund of all social groups, as far as suggesting solutions is concerned, is the medical profession as a whole. With a uniformity which suggests self-protection, it urges that as few new schemes as possible be considered, or that no new ones be tried. But with the apparent profound dissatisfaction of the millions of our people with medical things as they are, the plea from the profession that it be left alone is as futile as the caressing of the tide by the broom of the good lady. Change is inevitable. The only questions are, how soon and in what form?

Thus we find that there is no logical limit to the fields into which health departments have gone, or may go. True, even the best are still vastly futile. But our people in general are not nicely sensitive to professional futility. To extend the field would probably increase this futility quotient and result here and there in the well-known ex-

posure. For our people are ruthless to officials when at last their eyes are opened. Also, we find that the whole technique of giving medical service to our people is in a vast flux.

Granted then all the uncertainty, all the danger, and all the public demand, what is the factual basis for our seriously considering organized governmental effort on a large scale in the chronic disease field? With the sharp limitation of immigration and the falling birth and death rates, the average age of our population is increasing year by year. This is particularly marked in the "older" parts of our country; so that in the east the age composition of our people is approximately that of the European countries. Thus yearly we have a larger proportion of our population in the chronic disease age group. In Massachusetts we find that while about 15 per cent of our deaths are from communicable diseases (largely tuberculosis and pneumonia) over 60 per cent are from chronic disease. In two generations the average age at time of death has risen from 31 to 51. Yet during this time the average time of death for those over fifty has *decreased* a fraction of a year. Actually decreased! We find, also, that the average duration of disease prior to death has increased nearly four times in twenty years. That, of course, means more chronic and less acute deaths. Consider what that means in terms of costs for terminal hospitalization! We find chronic diseases appearing more and more prominently among the principal causes of death. This means that more and more of our people are experiencing in themselves or their relatives and friends personal suffering from chronic disease.

But deaths do not tell the whole story. They are more dramatic and more easily available than figures as to cases. But cases give a truer picture. Since the legislature ordered a cancer program some five years ago we have been collecting data on chronic disease morbidity from a representative sample of some 70,000 people. They show astonishing things. Eleven per cent of our total population,

and over one-quarter of those over fifty admit chronic disease. Nearly half a million people in Massachusetts are sick with chronic disease at any one time. While in the death columns heart leads (10,000), then cancer (5,000), and third, pneumonia (about 5,000), the morbidity figures show first rheumatism (145,000), second, heart disease (89,000), third, arteriosclerosis (56,000), fourth, nephritis (31,000), and fifth, cancer (10,000). Of these cases, 8.2 per cent, or one in every 109 persons, are completely disabled from chronic disease. Over one-third of all the chronically sick individuals, and two-thirds of the rheumatics, were receiving no treatment. Contrast this with the fact that in well-ordered arthritic clinics over two-thirds can be benefited. Also consider that in Massachusetts alone $8,000,000 in wages alone are lost annually on account of rheumatism. Yet two-thirds untreated, while two-thirds could be benefited with many more cured or prevented. Then as to duration, the untreated case of cancer averages two years, heart disease over nine years, and rheumatism over twelve years. Rheumatism cripples but does not kill! Hence its economic significance and its neglect. Surely with these facts no one can stop something being done for rheumatism. But what?

Then look at heart disease! Rheumatic heart disease in children! Every clinic is crying for beds where the little ones may receive the needed continued treatment to prevent extension of damage. In most of our cities beds for tonsillectomy are engaged ahead as eagerly as seats for the first night of the opera. Now the children with rheumatic heart disease go in and out of our general hospitals tragically and futilely. Investigations are under way and are cryingly needed. What is the relation of this infection in children to adult heart disease and rheumatism? How ominous the growing menace of heart disease, particularly in the medical profession! It has been said that a campaign for the control of heart disease among doctors should be instituted, since their rate is particularly high. Is this civilization a Frankenstein monster that will

destroy us through our cardio-vascular and synovial systems? But again, what to do?

In Massachusetts under a legislative mandate we have developed a cancer program. In a hospital of 115 beds with complete physical equipment, competent resident staff and a superlative visiting staff giving about three hundred hours per month, we are serving 1,000 patients a year, besides those handled in the weekly clinic. Practically all the hospitals that were serving cancer before are now finding a greater demand than ever, which would seem to demonstrate again that once the confidence of the public has been aroused the demand is practically incalculable.

In fifteen cities and towns state-aided clinics have been developed under the direction of committees appointed by the local medical societies. These serve over two thousand people a year of whom over five hundred have cancer. The proportion coming to these clinics from doctors has risen from 25 per cent to 36 per cent. The newspapers at first brought in two-thirds, but now only one-third of the patients. Our cancer program is less "news" as time goes on. Following a state-wide campaign we circularized all doctors and found that for every patient coming to a clinic there were 22 going to the private office and that there were more seeking private service in cities where there were clinics than where there were not. We are frantically striving for objective estimates of results. After two years we find that 15 per cent more of the cancers seen in the clinics in 1928 are still alive, than of those seen in 1927. The time is too short and the figures are too small and too crude, but as time goes on we will get something more valuable, because we are collecting data on morbidity such as was not previously available.

Education, or more properly, propaganda has gone on in alarming volume; all aimed to motivate the person with the persistent abnormality to seek competent medical advice promptly. The periodic physical examination, of

course, plays right into the hands of those interested in the earlier and earlier detection of any of the chronic diseases.

Under this program then we have set up resources against cancer that are being extensively used, and in an increasing amount by the private physician as adjuncts to the service which he can give. In private offices, clinics and hospitals we estimate in the last three years that over 80 per cent of the cancer in the state has been served. How early and how well it is yet premature to state. Yet there are a few indications which would seem to warrant slight optimism.

Is this then a crude pattern that might be somewhat followed in developing service to other chronic disease? Should we look to government setting up in clinics and hospitals the expensive equipment and special skill needed for the diagnosis, cure and alleviation of more and more of these diseases as the one antidote to the tidal wave of terminal hospitalization which may otherwise swamp us? May we hope that as the quality of these services is demonstrated the private physician will more and more utilize them selectively? So, perhaps, out of this, the indictment of official and professional indifference will be met, and we may be saved from the qualitative atrophy of complete medical socialization.

But if communities that are on the road to solving their environmental and communicable disease problems do take up the burden of organized efforts against chronic disease, shall this be assigned to the health department? Except for education as to whatever prevention our present knowledge may allow, for further education as to early signs and symptoms and perhaps for organized resources for early recognition, it is a problem of disease rather than health. Such a distinction is of more than academic importance since in the welter of the sick and the well the sick are likely to receive the maximum of attention because of the humanities, to the detriment of the primary responsibility of the health department.

In conclusion then, the growing burden of chronic disease will, as time goes on, demand organized governmental resources. These, it may well be decided to put under health departments. If so, meticulous care must be exercised that in the intricate diversities of adequate diagnostic and therapeutic service to the sick the cardinal responsibility of our health departments shall not be lost sight of —that of keeping the well well.

TROPICAL DISEASES AND PARASITIC INFECTIONS IN NEW YORK CITY*

F. W. O'Connor, M.R.C.S.

In view of expressed opinions regarding the prevalence or otherwise of tropical diseases in New York City, some preliminary observations have recently been made. As a result it appears that such infections and others due to animal parasites are abundant in this city.

Sources of Material

1. First in importance is the considerable number of residents who were born abroad, especially in the tropics. The Welfare Council of New York City conducts its work on an approximate estimate of 150,000 persons from Porto Rico alone. The Chinese population of the city numbers over 10,000. The Philippine population, principally in the Bronx, exceeds 5,000. Our own experience at the Presbyterian Hospital indicates that the population of persons from islands in the Caribbean other than Porto Rico and from Central and South America is also considerable.

2. Emigrants from Europe especially from the southern and eastern parts of the Continent furnish many cases of parasitic infections.

3. The foreign mission boards of the United States send more workers to the tropics than any similar organizations of other countries. The personnel of the Presbyterian, Methodist and Baptist Boards, including men, women and children totals 6,856 persons. Many of these pass through New York, where, through the coöperation of the various mission boards, it is possible to study their infections.

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*Read before the Section of Medicine, March 17, 1931.

4. In the United States itself there is a rich field of animal parasitism amongst the human population; this is especially true amongst the residents from the Southern States.

5. Up to date we have no definite figures of the number of sailors born in the tropics who visit our port, but a rough estimate shows that ninety-two steamship companies trading in the tropics have ships which arrive at New York and part of the crews of many of these were born in warm countries.

6. American commercial enterprises in the tropics have been increasing in number and scope for some years with a corresponding increase in the incidence of tropical disease amongst their employees. Similarly, there has been a growing number of cases of parasitism amongst scientific workers from this to tropical countries especially geologists, archeologists, explorers and the personnel of expeditions sent out by the various museums and universities.

7. Finally, as foreign travel grows more popular amongst the people of the United States it is not surprising that many cases come from those of this group whose interest takes them to warm countries.

The following figures from a very few institutions give some impression of the amount of material available in the city. Major E. C. Martindale, Director of the Department of Pathology at the U. S. Marine Hospital, in his annual report of laboratory studies shows that during 1930 two hundred blood films from cases of suspected malaria were sent to his laboratory, in sixty of which malarial parasites were found. At this institution also during the past seven years seven cases of granuloma inguinale were seen.

The figures for tropical diseases at the Long Island College Hospital for the years 1925-1929 are as follows:

Malaria	99
Amoebic dysentery	8
Kala-azar	3

Bilharzia	1
Actinomycosis	2
Granuloma inguinale	5
Filaria	1
Hookworm	1
Leprosy	5
Beri-beri	1

Dr. C. H. Lavinder reports as follows from the hospitals at Ellis Island and Staten Island for a five year period:

Malaria	420
Amoebiasis	40
Amoebic liver abscess	8
Leprosy	5
Beri-beri	2
Filariasis	2
Coccidiosis	1
Sprue	1
Pellagra	1

Captain Thomas of the U. S. Naval Hospital in Brooklyn reports the following for 1930:

Malaria	20
Amoebic liver abscess	2
Amoebic dysentery	5
Hookworm	3
Trichuris trichiura	3
Schistosoma japonicum	1

In the course of our own studies during a period of eighteen months the following have been observed:

Protozoal Infections.

Amoebiasis due to Entamoeba histolytica in all its clinical manifestations including liver abscess. Infections with all the known protozoa with the exception of coccidiosis. Malaria in all its three forms with mixed infections of these plasmodia.

African Trypanosomiasis.

Helminthic Infections.

a. Nematodes: Ascaris, Hookworm, Enterobius, Trichiniasis, Trichuris, Creeping Eruption, Loa loa, Acanthocheilonema perstans and every clinical manifestation of Filaria bancrofti.

b. Tapeworms: T. echinococcus, T. saginata, T. solium, Hymenolepis nana and Diphyllobothrium latum.

c. Trematodes: Schistosoma mansoni, Clonorchis sinensis, Paragonimus westermani and Fasciolopsis buski.

Bacterial Conditions Considered Tropical: Undulant Fever, Leprosy and Bacillary Dysentery.

Vitamin Deficiency Diseases: Pellagra and Beri-beri.

Diseases of Undetermined Etiology: Blackwater Fever, Yellow Fever, Typhus, Granuloma inguinale, Ainhum, Sprue and Climatic Bubo.

Skin Diseases: Dhobie Itch, Pinta, Madura Foot and Actinomycosis.

Amongst the foregoing the following have been the most prevalent:

Clinical amoebiasis (confirmed by microscopical examination)	66
Amoebic liver abscess	6
Hookworm	48
Filariasis (including 5 cases of chyluria)	60
Malaria	30
Sprue	6
Tapeworms	50

Considering that the above represent only a few of the medical institutes it will be readily appreciated that there is ample material for clinical studies and research in tropical disease and conditions due to animal parasites in New York City.

For the efficient study of tropical disease and its ultimate aim, prevention, it should be noted that other facilities are available. The high efficiency of the Public and Port Health Services suggest important possibilities for the study of marine hygiene and quarantine methods through coöperation with these organizations. For those interested in the study of comparative pathology and parasitology, the valuable collection at the Bronx Zoological Park, offers great opportunities. In connection with field studies so very necessary in tropical medicine New York is in a very strategic position. A night or two on the train will place one in our own South, which is rich in opportunities for the study of hookworm, ascaris infection, malaria, pellagra and leprosy, while in three to four days he can be in Porto Rico actively engaged in an even more varied field of disease.

EFFECT OF AIR POLLUTION ON HEALTH

Report of the Committee on Public Health Relations of the New York Academy of Medicine.

This report on the effect of air pollution on health is the outcome of a request made to the New York Academy of Medicine by Doctor Shirley W. Wynne, Commissioner of Health of New York City, asking that a committee be formed to study and report on the effect of air pollution on health. The report and conclusions are based upon a careful study of the literature of air pollution and its effect upon health; on correspondence and conferences with physicians and engineers (authorities on air pollution), and finally on the opinions of the members of the committee.

Since a bibliography of smoke and smoke prevention, collected by Elwood H. McClelland, has been published by the University of Pittsburgh, only a few references to the literature are included in this brief report.

Introduction.

Although the nuisance of smoke is present wherever fuel, rubbish, and gasoline are burned; although everyone abhors smoke, and 25 cities in the United States of more than 30,000 inhabitants have smoke ordinances, these ordinances are not strictly enforced because public opinion has not been sufficiently aroused to demand their enforcement. It was almost a hundred years after Ramazzini published his book on the effect of smoke on health before Laennec and others insisted on the importance of air pollution. The world is indebted to Traube for proving in 1860 that carbon in the air left its traces in the lungs, pleura, and glands of those who breathe such air.

The Mellon Institute of Industrial Research in Pitts-

burgh, under the able direction of H. B. Meller, instituted researches on air pollution in 1912. It is encouraging that similar work is now being carried on in several institutions and with the awakening of public interest and the support of scientific data proving the danger to health and the damage to property caused by air pollution, great improvement will soon be noticed in many cities of the United States.

Outline of Air Pollution Problem

Composition of Smoke and Soot.

Smoke is composed of soot (solid carbon particles resulting from incomplete combustion) and certain volatile gases—sulphuric oxid, carbon monoxid, carbon dioxid, sodium chloride, sulphuric acid, and nitrogen, sulphur, and arsenic compounds.

Sources of Smoke and Soot.

Locomotives, chimneys, boats and automobiles are the chief sources of smoke. A committee of the Academy of Medicine has studied and reported on carbon monoxid poisoning and the automobile exhaust (Carbon Monoxid Poisoning and the Automobile Exhaust, *Bull. N. Y. A. M.*, Aug., 1926, pp. 402-440).

Instruments for Investigations.

Several instruments and methods for determining the amount and type of air pollution are available.

Results of Investigation of Smoke.

An investigation conducted by the Mellon Institute of Pittsburgh in 1924 found the average deposit from smoke in that city to be 89.7 tons per square mile in one month. Records of the Weather Bureau in New York City for 1930 show that the deposit averaged 3.97 tons per square mile per month.

In Pittsburgh the amount of tar has decreased materially since 1913 while the combustibles other than tar and

ash have increased. The increase in solid matter deposited is due partly to an increase in the number of stacks, but principally to the fact that legislation has attempted to control only dense smoke which is possibly not as serious a menace to health as transparent poisonous smoke. It is hoped that further investigations of the poisonous effects of smoke may be made in New York City.

Substances Which Pollute the Air

1. *Sulphur.* Sulphur is present in smoke in the form of SO_2 (sulphur dioxid) and H_2SO_4 (sulphuric acid). It has been estimated that in London almost 50 tons of sulphur are poured into the air each day. In Glasgow and Manchester, it is stated, 20 tons escape each day in the smoke. According to Rideal, the quantity of sulphur present in the air of London, from different analyses, is from 0.15-0.77 grams per 100 cubic feet. At Kew, as much as 2% of sulphur was found in an analysis of dust from an exposed surface. According to Nicholson, one-half cwt. of sulphuric acid is deposited over every square mile of Manchester, and in Chelsea much more is deposited.

It is probable that sulphurous fumes are the most deadly of all the gaseous constituents of smoke. In this connection Evans states: "Sulphur compounds are very objectionable and probably more harmful than carbon compounds. Probably before long our dense smoke ordinances will be changed so as to add to the carbon control other provisions which will control sulphur compounds. Possibly, also, the combustion experiments will likewise be directed more to the solution of the sulphur problem."

Schaefer, who has made a special study of the effects of sulphur gases on health, attributes lasting and serious results to the inhalation of these gases. Sulphur fumes, he believes, play a large rôle in the etiology of asthma.

Ascher has cited experimental work done by Kimball on rabbits which demonstrated the fact that, by causing rabbits to breathe small quantities of sulphuric acid fumes the

number of tuberculous infections were increased. He also states that other experimental work has shown that sulphur inhalation causes a decrease in the bactericidal action in tuberculous lungs and a lowering of the power of resistance.

2. *Arsenic.* Most varieties of coal contain small quantities of arsenic. According to Cohen and Ruston arsenic found in air and water is derived from coal smoke.

3. *Carbon monoxid.* Carbon monoxid is a product of combustion. The smoke from iron furnaces contains from 25% to 35% of this gas.

Liesegang (*Klin. Woch.*, 1928, v. 7, pp. 463-5) regards the presence of carbon monoxid in the atmosphere as having a pronounced effect on city dwellers. He cites the estimate of a daily total of 124,000 cubic meters of carbon monoxid produced by motor cars in the city of Berlin. Studies in 1926 estimated that motor vehicles at 42nd Street and Fifth Avenue in New York City discharged 30,000 cubic feet of carbon monoxid in a day.

The present percentage (from 7 to 14 per cent) of carbon monoxid in automobile exhaust gases is unnecessarily high. A high content of this gas represents a heavy sacrifice of miles per gallon for the sake of power and ease in starting a cold motor. Ample power may be had from any machine from a CO content of but 3 per cent by volume of the exhaust gases, and the present average content of over 7 per cent is wasteful.

Kinnicut and Sanford state that "air containing 0.3% of carbon monoxid causes death, 0.2% very dangerous symptoms, and that mice will quickly show the effects of the gas when the air contains only 0.005%. It produces headache, vertigo, malaise, muscular weakness, nausea, and vomiting and finally drowsiness, loss of consciousness, and death. Continued breathing of carbon monoxid gas causes severe anemia and its sequelæ."

Human blood has such an affinity for carbon monoxid

that it is taken into the circulation when the atmosphere contains no more than .004% or 1/25,000 part (Fodor). The fatal effects often produced by this gas are due to the fact that hemoglobin has an affinity for carbon monoxid and the compound formed—carboxyhemoglobin—is much more stable than oxyhemoglobin. If any considerable quantity of carbon monoxid is present in the air the hemoglobin will be almost completely charged with carboxyhemoglobin and asphyxia will result (Haliburton).

The studies for the Public Health Committee of the New York Academy of Medicine by Professor Yandell Henderson show that under certain atmospheric conditions, when little breeze is stirring and traffic is heavy, the carbon monoxid content of the street air in New York City reaches a point where prolonged and continuous exposure to it may have deleterious effects.

Carbon dioxid. According to Tobold, carbon dioxid in a proportion of 1:10 acts as a poison causing headache and shortness of breath; 30% may cause death. Schaffer states that in London 100,000 tons of carbon dioxid are poured into the air as smoke each day. Coullard believes that a smoky atmosphere is poisonous because of the large quantity of carbon dioxid rather than because of a deficiency of oxygen.

Renk says, "Normal air contains about .03% while city air contains .03% to .05%. This is not sufficient to prove a menace to health, yet small amounts of excess carbon dioxid inhaled for long periods of time would, within limits, tend to have the effects somewhat similar to those produced by large amounts breathed for a short period of time"—namely, accumulation of carbon dioxid in the blood, abatement of oxidation within the organs, lowering of body temperature, loss of reflex transmission to the limbs, to the eyes, and finally paralysis of the respiratory center and death.

4. *Chlorine and Nitrogen Gases.* These gases probably play a minor rôle in the effect of smoke upon health. They

occur mainly in the smoke of industrial centers. Coullard believes that chlorine fumes, while slightly vitiating, do not cause serious disorders except through prolonged inhalation in which case they might light up a tuberculous process.

Nitrogen vapors act, according to Coullard, "(1) by powerfully irritating the bronchi and the small pulmonary vessels to the point of producing centers of apoplexy and (2) by producing a special impoverishment of the blood."

Instruments and Methods for Investigating Air Pollution.

Capnometer. From the beginning of the Mellon Institute's Air Pollution Investigation (L. W. Bass, *Science*, 70: 186, August 23, 1929), it was recognized that the photoelectric cell would play an important part in the determination of the amount of atmospheric contamination and its distribution outward and upward from sources. Sampling devices ordinarily enable one to estimate the content of solids in a small volume of air at a given time and place, or the total amount at a given place over a period of time. It was desirable, however, to have a continuous record, not only of the amount of pollution, but also of the effects of atmospheric conditions upon the distribution of solids after their emission from stacks or other sources.

With the helpful coöperation of members of the staff of the Westinghouse Research Laboratories, experiments were made first for work at short range, and in consequence a combination has been developed that may be used at night or in the daytime. It consists essentially of a source of light with a modulator, a receiver and amplifier, tuned, and an indicator or recorder, calibrated. It differs from "smoke indicators" in that it need not be attached to a smokepipe or stack and also in that it operates independently of any influence from daylight or artificial light other than that from the controlled source.

At the suggestion of W. A. Hamor, Assistant Director,

Mellon Institute, the apparatus has been named the capnometer (Greek *kapnos,* smoke, and *metron,* measure), for its purpose is to measure smoke—capnometry.

From the results of the work done in the laboratory the apparatus should be very helpful in securing data concerning the influence of furnace and firing conditions, precipitation, wind velocities, etc., upon the density due to pollution of the atmosphere. (From *Science,* March 28, 1930, vol. 71, No. 1839, pages 344-345).

Soot Fall Survey. Samples for this purpose are collected in jars or cans approximately four inches in diameter by ten inches high. These vessels are placed at various stations and changed monthly. The containers are cleansed and a small volume of distilled water is poured in to avoid loss of precipitate through the action of wind. Samples are analyzed to determine percentages of tar, and combustibles other than tar and ash.

Determination of Intensity of Daylight.

This can be determined by its effect in decomposing oxalic acid. Meller reports:

In 1912-1913 in Pittsburgh the intensity of daylight was determined by its effect in decomposing oxalic acid, thus: (a) This decomposition, on days when the presence of smoke or fog was recorded, was 75 per cent of what it was on days having practically the same number of hours of sunshine without the presence of fog or smoke in appreciable quantities. (b) A decrease of 39 per cent in the limit of visibility was accompanied by a decrease of 24 per cent in the decomposition of oxalic acid. (c) In the absence of smoke and fog there seemed to be little connection between the percentage of decomposition of oxalic acid and the limit of visibility. (d) There was an increase of acid decomposition with increase in the hours of sunshine.

Screening Effect of Soot.

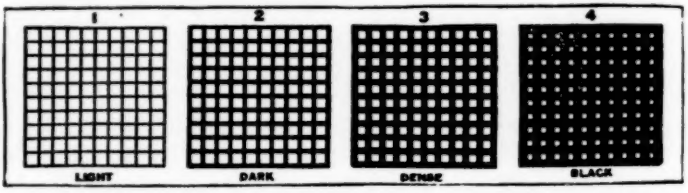
The accumulation of soot on skylights when exposed for a certain time interferes with the transmission of light. This

loss of light can be measured photometrically. In the smoky zone in Pittsburgh this was 80 per cent compared with about 40 per cent in one of the less smoky suburbs.

Measurement of Solar Radiations. This can be determined by an instrument called a spectograph. The spectograph is used for standardizing other instruments and for taking photographs of the solar spectrum.

Solid Matter in Suspension. This is sampled by the Owens Jet Dust Counter. The solid particles are precipitated on glass and the glass is then mounted on a slide for microscopic study. The number of particles are counted and the sizes are measured.

Density of Smoke. The density of smoke is measured by the Ringlemann Chart.



THE RINGLEMANN CHART USED IN PITTSBURGH

Place the chart on a line with a stack a sufficient distance from the eye to cause the lines to merge. Compare with the density of smoke under observation; if equal to or greater than 3, the smoke is a violation of the city ordinance and the operator is liable to penalty.

(Reprinted by permission from the May 1930 issue, *Scientific American*)

Determination of Carbon Monoxid. Carbon monoxid gas in the atmosphere is determined by the use of iodine pentoxid.

Effects of Air Pollution on General Health

The Chief Medical Officer of the Ministry of Health of England, in his annual report on the state of the public health for the year 1927, writes:

"The recognition of the dependency of health on sunlight

is part of the inherited experience of mankind and does not call for mathematical demonstration. We are, however, now gaining more exact knowledge of the nature of this relationship and the conditions which influence it. The beneficial effects of exposure to the sun's rays have been demonstrated, for example, in such diseases as surgical tuberculosis and rickets, and the result is seen not only in the direct effect on the obvious disease, but in a general stimulation of body growth. The importance of sunlight to healthy growth is increasingly realized and the rearing of healthy children requires that they should not be deprived of what is so essential to their well-being."

Sunshine is an important biodynamic agent. It promotes anabolism, transpiration, and respiration, and increases the percentage of hemoglobin. The blue and ultraviolet rays of sunshine exert a bactericidal effect on pathogenic bacteria, and a tonic, vitalizing influence on the feelings. Moreover, colorless daylight is superior for visual efficiency and eye health.

Dark clouds have a depressing, devitalizing effect.

Humidity increases the solid, poisonous, bacterial contents of the air, aggravates various pathological conditions of the body, reduces the sensitivity of some sense organs, and depletes the vital potential. Fogs, in addition, increase the inaccuracy of mental work, the prevalence of diseases, and augment the death rate.

Clear, dry days are anabolic in character and thus produce a superabundance of energy.

Liefman concludes that darkening of the atmosphere of our cities is injurious to health in three ways: (1) An exciting impulse which influences our disposition is weakened and the energy of metabolism, especially as it concerns respiration, is diminished. (2) The illumination and warming of the earth, the water and the air within the precincts of our great cities is diminished and in this way a series of hygienically important processes is in-

fluenced or depressed. (3) The chemical and bactericidal effect of the sun's rays is decreased and thus bacteria, especially the pathogenic ones, are permitted to thrive. (*Mellon Inst. Bull.*, No. 9.)

According to Sir William Ramsay, "Smoke is harmful by its power to absorb light directly and by its effect in the formation of clouds and fogs which are peculiarly fitted to absorb the blue, the violet and ultra-violet rays, these being the rays that are especially germicidal. Diminution of sunshine causes an increase of bacteria in the atmosphere." He also believes that sunshine has a direct influence on the human skin as well as upon the mental state.

Vision and Illumination and Ultra-Violet Rays

Cutting off sunshine and sky-shine (clouds reflect light) makes it necessary to use artificial light with its detrimental effect on vision.

Smoke acts as a curtain and cuts off the sun's direct rays, ultra-violet rays which are necessary for the healthy development not only of plants but of human beings. Rickets, anemia, and tuberculosis are likely to develop in children who are deprived of sunlight.

Doctor Henry F. Vaughan and Doctor Meader report that their "studies on sunlight have indicated that the rays at Northville, about twenty-five miles from the center of Detroit, contain about four times as much ultra-violet as do the rays in the city. This is apparently due to smoke."

Sir John Robertson, C.M.G., Medical Officer of Health, Birmingham, in his Annual Report for 1926, dealt at length with the smoke nuisance and its effects, and said that the extent to which the products of combustion are in the air of any large city has three chief influences on the inhabitants of the district: "It is prejudical to health, it causes a great deal of unnecessary labour and cleansing, and it limits the growth of many plants, and, therefore, hinders what is beautiful or useful in town gardens."

By far the most important of these, he considers, is the fact that all smoke or dust in the air shuts out, in direct proportion to its amount, the ultra-violet rays, and prevents them from reaching the dwellers in the area. "The absence of these rays for the greater part of the day lowers vitality, and by so doing renders most people susceptible to ailments which they themselves would not associate with the absence of sunlight."

"This deleterious effect," his report continues, "is for the most part produced by the very light and minute particles of soot which are carried high up in the air, and form by their presence an effective barrier to the sun's rays. It is possible to demonstrate this even when with unaided eyes the sun looks clear over the city."

McCollum of Johns Hopkins has shown that the growth-producing factor, Vitamin A, and the anti-rachitic factor in cod liver oil are not the same and the latter has been designated Vitamin D. In the earliest experiments it was found that the effect was produced by irradiating the animal, and it was supposed that in irradiating it, the cholesterol of the skin was activated in such a way that on absorption it so affected the lining membrane of the gut that the phosphorus and calcium became easily assimilable. This assumption was almost true. But it has since been proved that it is a substance always associated with the cholesterol which can be activated, viz., ergosterol, and it is this substance which, in various forms and under many names is now added to all the anti-rachitic proprietary preparations prominent in the medical market today.

Rickets is generally considered a disease of childhood and its far-reaching effects are often forgotten. Gynecologists dread the difficult labor of the woman deformed by rickets. The pelvic outlet is small. Spontaneous delivery is impossible. Instruments are necessary. There is danger of the soft parts being torn and sepsis supervening. Some believe that when this disease is wiped out there will be a coincident reduction in the puerperal fever rates.

The loss of light due to smoke in New York City is the subject of a recent report by the United States Public Health Service (*Public Health Bulletin,* No. 197). The results of this study may be briefly summarized as follows:

Records of the total horizontal illumination were obtained throughout the year 1927 with photo-electric cells and recording poteniometers simultaneously at the Hudson Street Marine Hospital, at the lower end of Manhattan Island, N. Y., where the air was very smoky, and on Hoffman Island, in lower New York Bay, about nine miles farther south, where the air was comparatively free from smoke.

From these records the average hourly horizontal illumination has been calculated for each of these two places for each month of the year. The daily average for each month and the hourly average for the year have also been calculated for each place. Both the absolute and the relative loss of light from smoke at the Hudson Street Hospital have been determined from the records.

The highest average daily horizontal illumination at Hoffman Island occurred in June and the lowest in December. The greatest total loss of light at the Hudson Street Hospital was in July and the least in December.

The records showed a large relative loss of light due to smoke. In some cases the average hourly or daily percentage loss was greater than 50 per cent. The average percentage loss for the whole year was 16.6 for clear days, 34.6 for cloudy days, and 21.5 for all days. The percentage loss on cloudy days was therefore about twice as great as on clear days.

An analysis of the results shows that the loss of light depends, among other things, upon the altitude of the sun, upon the nature of the daylight, whether from a clear or cloudy sky, upon the relative humidity of the air, and upon the velocity of the wind.

The effect of the altitude of the sun upon the percentage

loss of light is shown clearly in the variation of the percentage loss with the hour of the day. The average percentage loss throughout the year was 30.2 at 8:30 a. m., 16.5 at 1:30 p. m., and 21.0 at 3:30 p. m.

The average monthly percentage losses showed no marked seasonal variation, but did show a marked relation to the average monthly relative humidities, the percentage losses usually increasing and decreasing with the relative humidities. For clear days the greatest average monthly percentage loss was 23.1 in November and the least was 12.1 in May, with corresponding average relative humidities of 64.6 and 39.0 per cent. For cloudy days these values were 52.7 in September and 23.6 in December, with corresponding average relative humidities of 99.4 and 85.9 per cent.

Other conditions being the same, the average percentage loss of light was greater for cloudy days, or cloudy hours, than for clear days or clear hours; the percentage loss being about 1.5 times as great for cloudy days as for clear days, for relative humidities between 40 and 80 per cent, and for wind velocities between 10.0 and 19.9 miles per hour.

For the same kind of sky, clear or cloudy, the average percentage loss of light increased with increase of relative humidity. For a clear sky the average percentage loss was twice as great for a relative humidity of 65 per cent as for 35 per cent. For a cloudy sky the increase was not as great.

Other conditions being the same, the percentage loss of light was found to decrease as the velocity of the wind increased.

The percentage loss of light was found to be largely independent of the pressure of the water vapor in the atmosphere and therefore of the absolute humidity.

Respiratory Diseases

The inhalation of carbon particles, irritating fumes, and other atmospheric impurities irritate the mucous membrane of the nose and lower its resistance, thus rendering it liable to acute and chronic infections which may involve the ear. Irritation alone can produce congestion of the mucous membrane, secondary swelling of the turbinates, and vacuum frontal sinus headaches. Patients in whom the membranes are diseased and the ciliated epithelium destroyed have great difficulty in eliminating the irritating particles and are therefore more sensitive to atmospheric pollution. In addition to this there is no doubt that some patients can be sensitized to certain forms of air pollution with the usual allergic manifestations. According to Doctor Henning of Leipzig, enlargement of the tonsils is common in firemen because of the irritating effects of smoke. Redness and congestion of the pharynx and larynx and tendency to inflammation of these tissues are predisposed to by atmospheric pollution.

Effect of Air Pollution on the Lungs. Doctor H. Osborne (*Medical Officer*, 1928) says, "During periods of winter fog owing to certain barometric conditions and absence of wind, smoke cannot get away but accumulates in the lower air strata. As a consequence the proportion of impurity is enormously increased and the concentration of sulphuric acid in the air may be such as to cause irritation of the eyes, nose, and respiratory passages. It is a common experience of local medical practitioners to find their bronchitis patients dying in numbers during prolonged periods of winter fog." He concludes as follows: "I would like to invite attention to a very striking correlation which emerges from a comparison of health statistics for the year 1926 with previous years. The general death rate for the year (12.5 per 1,000 living) is the lowest ever recorded for Salford. The greatest reduction of mortality occurred in the great group of respiratory diseases and this fact associated with the occurrence of the prolonged coal dispute

and consequent relative purity of our atmosphere, is a matter of some significance."

H. K. Kugel, Acting Commissioner of Smoke Inspection, Cleveland, writes that the survey made by the Mellon Institute several years ago in Pittsburgh seemed to show that in certain parts of the city which were the smokiest, diseases of the respiratory tract were much more numerous. A similar survey was made a short time ago in Akron and apparently shows the same trend.

It is interesting to note that the annual death rate from pneumonia is greater than from all other infectious diseases combined. Smoke irritates the mucous membrane and predisposes to diseases of the respiratory tract, especially pneumonia.

Professor Sir Leonard Hill, M.B., F.R.S., in a lecture delivered at the Medical Officers of Health Conference, at Newcastle-on-Tyne, in June, 1929, said: "Respiratory diseases now cause 40 per cent to 50 per cent of the lost time in workshops and offices and produce a vast amount of lessened efficiency and suffering."

Taylor says, as a result of inhaling about 35 lbs. of air daily, dwellers in the industrial cities have lungs more or less similar to those of the coal miner, not pinkish in color like those of a child or one who tills the field, but blackened, both on the surface and in the depths, due to the deposit of carbon. The tarry matter and the less visible sulphur acids which are far more dangerous than the carbon, set up an irritation in the mucous lining of the windpipe and smaller tubes. Chronic catarrh supervenes. The mucous lining becomes rough and thickened, the surrounding tissues lose their elasticity and become leathery in texture. These changes produce symptoms of chronic bronchitis, symptoms resulting from persistent irritation, partial collapse of the lungs, and incomplete oxygenation of the blood.

Dr. W. A. Brend has examined the main factors which

might be held to account for a high rate of infantile mortality and finds that differences "neither in poverty, bad housing, insufficient feeding, defective sanitation, disease, industrial occupation of women, nor malnutrition of mothers can be regarded as adequate to explain the excessive and widespread difference between urban and rural rate of infant mortality." Dr. Stevenson believes that chances of survival differ but little at birth in town and in the country, but the noxious influences of the former soon come into play, and make themselves felt to an increasing extent as the first year of life progresses, and to a still greater extent in the second and third years.

Brend believes that the noxious influence is "a smoky and dusty atmosphere and that as a cause of infant mortality it transcends all other influences," and if one of the main effects of soot is to cause bronchitis and lower the resistance of the respiratory organs then his argument is borne out by such figures as these:

Roughly 1/12th or all the deaths in England and Wales are due to respiratory diseases. In Manchester the respiratory death rate is twice as great. For all rural England the infantile death rate for 1928 due to pneumonia and bronchitis was 8.8, for the county boroughs 16.27, and for Manchester 23.16.

Professor Sir Leonard Hill, M.B., F.R.S., in a lecture at the Royal Sanitary Institute Congress at Bournemouth in 1922, said:

"Men live long who work in the clean open air of the fields: thus the expectation of life of females at birth in Westmoreland is 61, in Middlesborough 46 years. This is not merely a matter of greater infant mortality, for at age 15 the difference is 5½ years. Similarly for young adult females, Surry County has an advantage of nine years over smoky industrial Oldham, while the urban mortality per 1,000 living on the whole for males is one-third greater than the rural mortality—a proportion which has not changed in the last 50 years, although the mortality has

been generally lowered. This difference is very striking considering the good water supply, drainage and cleaning of the cities and the higher wages earned by city workers. . . ."

"In this country tuberculosis still kills and maims each year almost as many civilians as the great war did of our soldiers. In Japan there is now happening just what happened in England during the rise of industry at the beginning of the last century. Some 210,000 fresh girls are coming annually into the cotton mills from the country districts, while some 80,000 girls in the mills are annually discharged for sickness, and no less than 70 per cent of all their deaths is due to tuberculosis."

Seltman concludes that a deposit of coal in the lungs, as soon as it reaches a certain degree, diminishes the gaseous exchange by decreasing the breathing surface, checks the formation of blood, and so causes anemia and dyspnea. Vital statistics afford the most readily available standard of comparison. Dr. Louis Ascher concludes from his statistical studies, "The increase in the mortality of acute lung diseases must be the result of some harmful factor which, it is true, is found in agricultural communities, but with a much higher increase in industrial centers. This factor is not limited to the places of industrial work but is also found in the homes, as proved by the mortality tables for infants and old people. The cause of this increase can only be the smoke of the coal fires."

Trudeau's experiments on animals are considered by some authorities as evidence of the importance of sunlight in the cure of tuberculosis.

Trudeau says (*An Autobiography of Edward L. Trudeau, M.D.*) "Lot 1, of five rabbits, were inoculated with pure cultures and put under the best surroundings of light, food and air attainable.

Lot 2, of five rabbits, inoculated at the same time and in the same way, were put under the worst conditions of environment I could devise.

Lot 3, of five rabbits were put under similar bad conditions without being inoculated.

Lot 1, I turned loose on a little island in front of my camp at Paul Smith's, where they ran wild all summer in the fresh air and sunshine, and were provided with abundant food. Lot 2 and Lot 3 were put in a dark, damp place where the air was bad, confined in a small box and fed insufficiently. The results showed that of the rabbits allowed to run wild under good conditions, all, with one exception, recovered. Of Lot 2, the same as Lot 1, but put in unfavorable surrouudings, four rabbits died within three months and the organs showed extensive tuberculosis. Lot 3, uninoculated animals, were then killed, and though emaciated, they showed no tuberculous disease.

This showed me conclusively that bad surroundings of themselves could not produce tuberculosis, and that when once the germs had gained entrance to the body the course of the disease was greatly influenced by a favorable or an unfavorable environment."

Effect of Air Pollution on the Eye

Solid and vaporous ingredients of smoke-begrimed air irritate the sensitive membranes of the eye, and aggravate or cause inflammatory conditions, increasing susceptibility of the tissues to conjunctivitis. The functional efficiency of the eye may also be more or less disabled by the constant irritation of solid particles.

That smoke materially decreases the limits of visibility is evident when we learn that these limits vary with the number of dust particles in the air. For example, 1000 particles per cubic centimeter render large objects like mountains invisible at a distance of 100 miles; 100,000 particles render them invisible 1 mile away, and 1,000,000 particles 1/10 of a mile distant (Aitken).

The optical value of *good daylight* can hardly be overestimated. Daylight is relatively colorless because it contains both chromatic and achromatic light. A bright

colorless illumination is best from the standpoint of visual efficiency and health. It is less fatiguing than colored light or than intense or dull artificial light. Electric lights never quite replace daylight and are often too intense because of the proximity of the light or because the rays are thrown directly into the eyes or directly upon the object under observation. These conditions may lead to overstimulation of the sensitive layers of the retina. During the dark days which are common in manufacturing cities lights must be kept burning in the homes, schools, shops, and factories all day. This fact has been determined by Blair for the Pittsburgh schools. Even on clear days the lights must be turned on very early in the evening. The intensity of artificial illumination does not always meet the requirements of visual health. Worse still is the condition of those who, through financial limitations, must work in the dark gloom of smoky days without the aid of artificial light.

J. E. Wallin (*Optical Illusions of Reversible Perspective,* 1905) has shown in a special experiment on the visual estimation of distances that bright objects are judged to be nearer the observer than similar black objects when placed at the same distance. If this is true, anything on which the eyes must be fixated in darkened illumination will be imperfectly envisaged. To overcome this optical handicap, there is a strong tendency to move the object too near the eyes. If done repeatedly this entails a severe strain on the muscles of accommodation, causing increased muscular fatigue, which may result in muscular imbalance. On the other hand, by illuminating an object with good daylight it will be made to appear nearer to the eye. The result is that objects will actually be held at a greater distance and distant objects will be seen without eyestrain.

Psychological Aspects of Air Pollution

The psychological effects of smoke are direct and indirect (Mellon Institute of Industrial Research and School of Specific Industries, *Smoke Investigation Bulletin,* No.

3). The indirect effects result from bodily changes produced by smoke or smoke-produced weather states, while the direct effects are due to the influences of the mind's own states upon its subsequent thoughts, disposition, and conduct. Smoke diminishes the potential reserve, working capacity, and well-being of the individual, increases fatigue, irritability and restlessness, whereas sunshine exerts an exuberant influence on the feelings, thus producing a superabundance of energy.

Dark clouds have a depressing, devitalizing effect. They may cause fear in children, and reduce working efficiency.

Our knowledge of the psychological reactions to atmospheric smoke pollution should be increased by systematic research using the questionnaire method and the experimental method with controlled subjects, controlled apparatus, and controlled smoke rooms.

Effect of Air Pollution on Climate and Health

Fogs.

Meller says, "The presence of sulphur acids resulting from combustion of fuel is believed to increase the probability of the formation and maintenance of fog in two ways. (1) In the presence of sunshine, nuclei are formed which have such an affinity for water that condensation sets in at temperatures higher than the saturation temperature. (2) Chemical affinity soon arrests the process of differentiation referred to, so that the fog particles maintain a small size and may be supported in the atmosphere for a long period."

Measurements made at the Mellon Institute showed that the weight of solids per 1000 cubic feet of air was twice as great in smoky atmosphere as in clear air.

Aitken says, (*Transactions of the Royal Society of Edinburgh,* v. 30, p. 337-368, 1883) "On account of the affinity between dust particles and vapor, each dust particle tends to take the same amount of vapor. This tends to equality in

the size of cloud particles and tends to prevent formation of larger drops by collision and union of cloud particles. As a result, the condensed vapor cloud instead of falling in minute parts as rain, tends to fall as a whole, the air becomes so loaded with the water held in the mechanical suspension that it is dragged downwards by its weight, causing fogs."

Brodie's data, with discussion, (*Quarterly Journal of the Royal Meteorological Society*, v. 31, p. 15-28) show steady decrease of fog since 1890. He thinks the result is largely due to substitution of gas for coal fuel.

Russel says (*Nature*, v. 39, p. 34-36) (Abstract of address delivered March 1, 1888, under the auspices of the Smoke Abatement Institution): "If London were to cease using fuel in the solid form, it would be as free from fog as the surrounding country." He discusses the economic disadvantage and the "moral reaction" of smoke and fog.

The following is an extract from Dr. René Sand's letter to Dr. E. H. L. Corwin, January 26th, 1931, in regard to the fog in the Meuse Valley: "The question of the 'deadly fog' in the Meuse Valley is in the hands of a committee. Many young and perfectly healthy people have died from it, and there is not the slightest doubt that some fumes (fluorhydric acid or sulphur dioxid), which are thrown daily in great quantities into the atmosphere by local factories, have been brought down near the soil and have accumulated through a very rare combination of atmospheric circumstances such as absolute quietness of the air, persistent and dense fog. It has always been a matter of surprise to me that factories are permitted to pollute the streams and the atmosphere without practically any check. One knows that in a radius of several miles around certain factories, trees wither and grass does not grow. When motoring through certain parts of the Meuse Valley, one is often half choked by poisonous fumes. Still we leave it at that, although as you know, devices have been found which would not even be very costly, as they permit the recovery of certain valuable chemical substances. The present sit-

uation is one of the worst examples of stupidity and neglect."

Effect of Air Pollution on Vegetation and Secondarily on Health

Delepine says, "The large amount of arsenic in soot causes a marked arsenical contamination of the air in Manchester and may account for the bad effect of air on vegetation."

Meller believes that the injury done to vegetation by the soot in smoke is probably due chiefly to the accompanying ash, tar, and gases. Fumes containing sulphur dioxid and sulphur trioxid do considerable injury to vegetation. It is also known that certain of the hydrocarbon gases, carbon monoxid, hydrogen sulphid, and carbon disulphid are injurious to plants.

Soot is poisonous to vegetation as evidenced by external appearance, and also by internal appearance as shown by the size of the annular rings and by lesions in the leaves.

Professor F. E. Wynne, Medical Officer of Health for Sheffield, in a paper read at Lancaster in March, 1929, said: "The damage done by the deposition of soot can be more accurately measured in the case of vegetable life than animal life, and this has been done by Dr. A. E. Rushton of Leeds University. In one of his experiments, hollyhocks from the parent stock were grown in tubs of identical soil in different parts of the city. In the most polluted part of the industrial area, during the second year of the experiment, only one plant survived. It grew to a height of nine inches and failed to flower. In a comparatively smokeless area, some miles north of the city, a growth of eight feet was obtained with full flowering. The damage caused by soot therefore begins with vegetation and its consequent deterioration of our milk and meat supplies."

Professor Sir Leonard Hill (1922) states: "The choking of the leaves by tarry matter and the sulphur acids in

the smoke destroys vegetation and lessens the pleasure and health derived from the cultivation of gardens and the use and enjoyment of public parks. Radishes and lettuces grown at stages between the center and the suburbs of Leeds show enormous increase in size concurrently with the great distance between the producing ground and the city. The destruction of vegetation is of very great importance to health, not only from the æsthetic side but from the fact that fresh green foods and the milk of cows fed on such are protective foods containing vitamins essential for health, growth and breeding. The want of these is one of the great causes of malnutrition, disease and infertility in our big cities."

Prevention of Air Pollution.

Prevention is the only cure. This is primarily an engineering problem and concerns the Department of Health. The laws seem to be sufficient in number and probably are sufficiently drastic in the present state of our knowledge. Complete realization of the importance of air pollution to health and aroused public opinion will undoubtedly strengthen the position of our courts in dealing with this important problem.

Summary and Conclusions.

1. There is an air pollution problem in New York City and other cities, which is a serious menace to health.

2. Although sanitation has progressed in many ways, the important problem of air pollution is still inadequately controlled.

3. The main sources of air pollution are locomotives, chimneys, boats, and automobiles.

4. Legislative and remedial measures at the present time are concerned with visible smoke alone, but the invisible products of combustion, sulphuric acid, sulphur dioxid, arsenic, carbon monoxid, carbon dioxid, and other poisons are a serious menace to health.

5. Instruments, apparatus, and methods are available for the detection and analysis of air pollution.

6. That air pollution exists in New York City is shown by the fact that deposits in New York in 1930 averaged 3.97 tons per square mile per month. The United States Public Health Records showed a large relative loss of light and healthgiving rays in New York City in 1927 and the presence of soot was a contributing factor. In some cases the average hourly or daily loss was greater than 50 per cent and the average daily loss for the year was 21.5 per cent. Studies of the carbon monoxid content of the air in New York City streets by Yandell Henderson showed that the amount of this poisonous gas was sufficient at times to produce deleterious effects.

7. Inhalation of carbon particles and irritating fumes lower the resistance of the nasal mucous membrane, rendering it susceptible to acute and chronic infections which may involve the ear. Enlargement of the tonsils, redness and congestion of the pharynx and larynx have also been ascribed to atmospheric pollution. Smoke likewise irritates the membranes of the entire respiratory tract, predisposing to pneumonia, and emphysema. Certain types of air pollution may sensitize the individual and produce allergic manifestations.

8. According to Oliver, "something is present in soot which irritates the skin and leads to cancer." This substance is now thought to be tar and may be a possible factor in the causation of cancer of the lung, the incidence of which is apparently increasing.

9. The sensitive membranes of the eye are inflamed by gases and particles of carbon, thus increasing the liability to conjunctivitis. Artificial light, necessary because of the smoke laden atmosphere, may be so intense as to overstimulate the sensitive layers of the retina, and low artificial and daylight illumination may cause eyestrain.

10. Smoke diminishes the potential reserve, working capacity, and well-being of the individual, and increases

fatigue and irritability, whereas sunshine exerts an exuberant influence on the feelings.

11. Although soot has a bactericidal action (Holman, W. K., *Am. Journal Public Health,* vol. 3, No. 11), smoky and humid weather conditions increase the bacterial content of the air (Russel, F. A. R., *Smithsonian Report,* 1895) and fogs increase the prevalence of disease. René Sand says that many young and healthy people died from the deadly fog in the Meuse Valley, due to fumes from local factories (fluorhydric acid or sulphur dioxid) which accumulated near the ground through a rare combination of atmospheric circumstances.

12. Vegetation is injured by smoke, as evidenced by experiments with plants grown in identical soil in smokeless and smoke-polluted districts.

13. That air pollution has a definite effect in increasing the incidence and death rate from tuberculosis is borne out by the classical experiments of Doctor Trudeau on animals; the accepted bactericidal action of sunlight; the healing reaction exhibited by extra-pulmonary tuberculous lesions when treated by the ultra-violet rays of the sun, and finally the low tuberculosis death rate of the states in which the population is largely rural as compared with the eastern industrial states.

14. The offensive odor of the exhaust smoke of automobiles, and of burning garbage and refuse, is not only a source of annoyance, but the odor may be so disagreeable as to disturb sleep.

15. Prevention of air pollution is a public health and engineering problem; the law is sufficiently comprehensive in the present state of our knowledge, but it should be strengthened by aroused public opinion and by courageous court action.

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DEATHS OF FELLOWS OF THE ACADEMY

Samuel Morley Evans, 20 East 76th Street, New York City; graduated in medicine from the College of Physicians and Surgeons, New York City, 1895; elected a Fellow of the Academy January 4, 1900; died August 19, 1931.

John Pixley Munn, M.D., 18 West 58th Street, New York City; graduated in medicine from Bellevue Hospital Medical College in 1876; elected a Fellow of the Academy, October, 1882; died, August 15, 1931. Dr. Munn was a Fellow of the American Medical Association and a member of the County and State Medical Societies. He was medical director and later president of the United States Life Insurance Company and from 1879 to 1892 was curator of St. Luke's Hospital.